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Community Perspectives of Mathematics and Statistics Support in Higher Education: The Role of the Staff Member

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Abstract

Mathematics support now forms a widely accepted and important part of the provision of higher education institutions within the UK and Ireland to assist students within their learning of mathematics and statistics, particularly as they make the transition to university study. Over the last 15 years it has seen growth as an area of scholarship, and behind this has been the role of those staff members who oversee, develop, deliver and research mathematics support within their institutions. To date, however, there has been little work that explores the roles, opportunities and recognition afforded to such individuals, but this is important if visibility for mathematics support as part of the provision and practice of higher education institutions is to continue to grow and a sustainable community of practitioners is to be established. Here we report on a survey of 51 individuals with responsibility for the day-to-day operation of the mathematics and statistics support provision within their institutions. Findings show that the majority of staff with such responsibility for the delivery of mathematics support within institutions are in permanent roles and that in many instances this forms the sole focus of their employment; there also exists an important and visible role for postgraduates in the delivery of mathematics support. Finally, there is evidence that most staff working in this area feel recognised and well supported with opportunities to develop their roles, engage with professional development, and to contribute to a national community of practice.

1. Introduction

Mathematics and statistics support is now widely accepted by higher education institutions as a vital means of helping students develop their mathematical and statistical skills, particularly as they make the transition to university study. As this paper forms a continuation of previously described work (Grove et al, 2017), we choose not to repeat here the background or rationale for mathematics support, but at its heart are those individuals

whose role it is to work with students to provide advice and guidance to aid their learning of mathematics and statistics.

The backgrounds of those working in mathematics and statistics support vary greatly: for example, they can be academic staff, including professors, who also undertake teaching duties as part of academic programmes; staff appointed directly to a mathematics or statistics support role, including former school teachers; or postgraduate (and, in some instances, undergraduate) students. In addition, their role may be broader than one of providing support alone – it may encompass co-ordinating or leading the mathematics support provision offered by an institution, including raising its profile and awareness of its existence amongst staff and students. Some staff have broader roles, for example in contributing to a university's widening participation initiatives.

Working in a mathematics support centre is very different from other forms of university teaching and requires a set of skills and abilities that not everyone possesses. As Croft and Grove (2016) observe: "*Providing mathematics support is not about 'telling' the student the answer, but about encouraging them to identify their own mathematical problems, helping them tackle these for themselves with support and guidance, and providing suggestions and strategies for independent study. It requires individuals who are comfortable working on a one-to-one basis, who are patient, able to explain mathematical ideas in multiple ways, have excellent interpersonal skills, and are able to work with students of a range of abilities and from different disciplinary areas*." Given the broad spectrum of levels and subjects that mathematics and statistics support encompasses (see for example Croft et al, 2015), mathematics support tutors have diverse, challenging, and vital student-facing roles.

While there has been much work exploring the extent and nature of mathematics and statistics support provision within higher education, there has been little that focuses upon the individuals who are essential to, and at the front-line of, providing this support. Such exploration is timely as there are a growing number of reports highlighting the increase in teaching-focused (or teaching only) academic roles and the drivers behind this trend in higher education. For example, in a UK review undertaken by Locke (2014), he concludes: "*It is a truism to emphasise the importance of staff in higher education, and especially those involved in the key functions (whatever their contractual status), to achieving future success. Yet, it is also true that the wellbeing and professionalism of these staff have largely been obscured by the recent narrow focus on the 'student experience', financial issues and the economic benefits of HE*". The growth of mathematics support over recent times is well documented (see for example Perkin et al, 2012); Kyle (2010) noted the emergence of mathematics support as an area of academic study; and, Grove et al (2017) identified that mathematics support is increasingly aligned as part of a wider institutional offer to support students with their learning rather than being based within academic departments. As such, there is an increasing number of staff working in mathematics and statistics support as their

primary or substantive duty, and here we present the results of a 2016 survey, first described in Grove et al (2017), that explores the roles, recognition and opportunities for development for these individuals within the UK.

2. Research Methodology

The research methodology is described in full in Grove et al (2017). In summary, data were obtained through an online survey targeted at those with responsibility for the day-to-day operation of the mathematics and statistics support provision within their institutions. Appropriate ethical guidelines (BERA, 2011) were followed in conducting the research: its purpose was made clear at the outset, and responses were received on an entirely 'opt-in' basis. While personal information was collected, this was to assist should further follow-up be required. Any information that might identify an individual has been anonymised in the analysis that follows, and where changes have been made to quotations this is solely for the purpose of maintaining the anonymity of responses; any such changes are shown in [square brackets]. Relevant here is that a total of 51 responses were received from staff members representing 47 higher education institutions from across the UK.

Using the results of the survey, Grove et al (2017) considered the sustainability of mathematics support, at an institutional level, by applying a framework of 10 indicators developed by Grove and Pugh (2017) for analysing the sustainability of learning and teaching initiatives. Here we extend this work by applying their remaining (three) indicators to consider sustainability in the context of the individuals who dedicate their work and academic endeavours to the area of mathematics and statistics support within higher education.

3. The Role of the Individual in Mathematics and Statistics Support

Those responding to the survey on behalf of their institutions possessed a wide range of job titles. They ranged from academic titles (including teaching fellow, lecturer, senior lecturer, reader, and head of an academic department), to those where specific involvement in delivering mathematics and statistics support was clearly articulated (including maths support advisor, numeracy tutor, and maths adviser). For those managing/overseeing mathematics support provision, words such as coordinator, manager, director, and development officer were all referenced in their job titles. Also responding were individuals who had job titles that did not explicitly reference mathematics support, but instead indicated alignment with wider institutional initiatives (including head of academic skills, head of study skills, learning support manager, student learning advisor, learning enhancement tutor, and academic skills advisor).

From job titles alone it appears that for many involved in either managing or delivering mathematics support this may not be the sole or even substantive focus of their role. Table 1 analyses the proportion of their role individuals felt was related to mathematics and statistics support. The findings here indicate that for many involved in mathematics and

statistics support this forms only a component of a wider portfolio of activity. For example, 40% of respondents indicated that they spent on average two-days or less working on mathematics and statistics support, and almost 20% indicated this was less than half a day per week (in one instance this was estimated to be as low as 25 minutes per week).

	Percentage of role dedicated to mathematics support	≤10%	10<t≤40 %	40<t≤70 %	70<t≤99 %	100%	Not specified		Totals
Contract type									
Academic		7	3	1	1	7	2		**21**
Other		2	8	2	1	15	2		**30**
Totals		**9**	**11**	**3**	**2**	**22**	**4**		**51**

Table 1: Proportion of work time, t, dedicated to mathematics and statistics support. The 'Other' grouping includes those on 'Academic Related', 'Professional/Managerial' and 'Administrative' contract types (n=51).

At an overarching level it is interesting to observe that there are a significant number of appointments (representing just over 40% of respondents) who indicated that the sole focus of their role was upon mathematics and statistics support. Interestingly, of these 'sole focus' roles, just under a third were classified as 'academic' with staff holding academic contracts; for roles where mathematics and statistics support formed only a proportion of an individual's duties, just under 50% of respondents were on academic contracts. More broadly this reinforces the findings of Tolley and Mackenzie (2015) by suggesting institutions are investing strategically in their mathematics and statistics support provision and recognises the important role that specialist individuals have in the institutional provision of mathematics and statistics support.

While Table 1 highlights the proportion of individual roles working on activities associated with mathematics and statistics support, it does not make an important distinction: that is the extent to which, during a typical week, staff spend their time (a) delivering mathematics support to learners, or (b) managing/coordinating the institutional support provision. Tables 2a and 2b explore this aspect, although a caveat is needed in relation to part-time staff – here the full-time equivalent (FTE) level was not requested, and as such, those indicating they spend, for example 10 hours, delivering support, could be spending all of their working time on this activity.

Typical hours per week delivering mathematics support ➔	Up to 3 hours	3-6 hours	6-10 hours	Over 10 hours	Not specified/ applicable		Totals
Contract type ⬇							
Academic	13	2	3	3	0		**21**
Other	5	1	10	12	2		**30**
Totals	**18**	**3**	**13**	**15**	**2**		**51**

Table 2a: Typical hours per week spent on providing mathematics support to learners. Again the 'Other' grouping includes those on 'Academic Related', 'Professional/Managerial' and 'Administrative' contract types (n=51).

Typical Hours Per Week: delivering mathematics support ➔	Up to 3 hours	3-6 hours	6-10 hours	Over 10 hours	Not specified/ applicable		Totals
Contract Type ⬇							
Academic	12	3	0	4	2		**21**
Other	7	7	6	10	0		**30**
Totals	**19**	**10**	**6**	**14**	**2**		**51**

Table 2b: Typical hours per week spent on co-ordinating, organising, promoting and managing mathematics support (n=51).

It is interesting to note that of those delivering more than six hours of mathematics support to learners, almost 80% were on non-academic contracts, that is those that are classified as either 'Academic Related', 'Professional/`managerial' or 'Administrative'. The type of contract is significant for a number of reasons: not only are such individuals providing a challenging form of academic tutoring with individuals who may be at high-risk of dropping out, but for those on contracts other than 'Academic', progression opportunities are typically more limited. Those on academic contracts can make a case (usually on an annual basis) for promotion based upon performance whereas those on other contract types may have to lobby to have their roles reclassified or explore opportunities elsewhere for promotion. This latter outcome highlights a potentially significant risk for the stability and development of mathematics and statistics support within an institution if clear opportunities for staff progression and promotion are not in place.

The evidence in Tables 2a and 2b appears to suggest that academic staff have a much more limited role (at least in terms of the proportion of their time allocated), in either delivering mathematics support or managing it; almost 60% of academic staff who responded indicated their involvement in mathematics support was typically less than three-hours per week. It may be the case that while academic staff, who are typically based within departments, do still have an involvement in mathematics support, they are involved more as 'champions' or 'advisors'. This may reflect a trend towards a more institutional-wide approach to the provision of mathematics support rather than a departmentally based model, and in doing so reinforces the findings of Tolley and Mackenzie (2015) who in their discussions with university senior management noted that "*the reported challenges were distributed across programmes of study in a wide range of subjects*".

The changing contractual backgrounds of those involved in mathematics support represents a potentially wider issue. Over the last 10 – 15 years there has been a growing visibility of mathematics and statistics support within the body of scholarly works. For example, in their 2012 survey, Perkin et al (2012) found "*there were 27 universities which have external publications relating to their mathematics support*", and in the same year the extensive publication of Matthews et al (2012) made available reviews and syntheses of published research (having considered almost 80 scholarly works) into how mathematics support professionals collect and analyse data to evidence usage of the support and the impact of the support on students, staff and the institution. Academic staff have been one of the key contributors to this body of scholarly knowledge, and this is unsurprising since it is typically those on this contract type that have the allocated time, flexibility, and indeed expectation, that they will pursue research and scholarly endeavours as part of their roles. With evidence that there appears to be a reduced involvement of academic staff with mathematics support, and that the delivery and management of mathematics support is taking place by those typically on non-academic contracts, there are implications as to whether this community-wide sharing of scholarly knowledge will continue at the same pace and to the same extent.

While this survey was targeted at those with responsibility for the day-to-day operation of the mathematics and statistics support provision within their institutions, it is recognised that there is another cadre of staff whose role focuses upon the delivery of mathematics support to learners. The involvement of these individuals as tutors, who we will discuss further in Section 6, may present a further perspective on the range of contract types possessed by those working in mathematics and statistics support within higher education.

4. Responsive and Reactive Provision

Mathematics and statistics support has not remained static and key to this has been the role of staff members working in this area. As noted by Kyle (2010) "*colleagues have moved on*

to gather data on the way students use such resources and look for optimal strategies for the delivery of this support". The scholarly approach that has been adopted by many of those delivering mathematics support has meant that the provision itself has evolved, resulting in a broader range of students being targeted and the exploration of new and dynamic ways of engaging with learners throughout an institution and throughout the academic cycle.

In the survey respondents were asked to articulate whether their mathematics and statistics support provision was open to all students within their institution or whether it was restricted to certain disciplines or years. Overwhelmingly (37 responses) it was the case that mathematics and statistics support was indicated as being available to all students within the institution. There were two instances noted (both large research intensive universities) whereby students from the later years of mathematics degrees were also attending and support was offered, even though this was not the primary mission of centres:

> "*Officially we exist for first and foundation year students only, and mainly for students not studying for a degree in maths. In practice though our drop-ins are attended by students from all years and many disciplines, including mathematics, and we don't turn any of these people away without attempting to help them."*

And in another institution such specialist mathematics students were able to engage, but other cohorts were given priority:

> *"…although mathematics students higher than first year undergrad are permitted to use the service, they have lower priority than other students."*

This clearly highlights a broadening of the role of mathematics support, and the related challenges for those who provide it. In its earliest stage (Hawkes and Savage, 2000), mathematics support was established to support those students in the disciplines of mathematics, engineering and physics with their learning of mathematics as they made the transition to university study. As such, the provision addressed what might be termed 'basic introductory techniques' such as those typically expected at foundation or first-year. Here there exists evidence that the extension of this remit can put additional demands upon mathematics support services.

Seven institutions limited their support to certain disciplines, including one large research-intensive institution, who noted that their provision was unavailable to specialist mathematics students. In others, there were instances where postgraduate research students were specifically discouraged from using the available support:

> *"PGR students are not encouraged to use the service."*

But in others, it is targeted at such students:

> "*...the statistics workshops are offered through the graduate school, and are only open to postgraduate students."*

In addition to the diversity of the target cohorts, it is also particularly interesting to note how there is now increasing usage of what might be termed 'hybrid' models of mathematics and statistics support in order to maximise engagement from particular cohorts of learner. For example in one institution where there exists both a departmental and centralised mathematics support service:

> *"…many more biosciences students use our departmental service than go to the centralised alternative."*

There also appears to be an increasingly common feature of mathematics support whereby in addition to provision that is available to any student, specialist support sessions are offered for particular cohorts that are linked to the work of their home department:

> "*...targeted provision tailored at a school, programme or module level. This takes the form of embedded sessions within timetabled lectures or seminars or sessions which are promoted to particular cohorts taking place directly after lecture."*

> *"Some colleges/departments also offer specific support just for their students…"*

This forms an interesting development. Mathematics support was originally, and almost primarily, structured around a model whereby an individual student could 'drop-in' to a centre or location and seek advice and guidance from a tutor at a time to suit them to aid their mathematical learning; one of the key benefits of this approach recognised by students is the ability to engage in individual mathematical dialogue with a tutor about their learning. Here there is evidence of a move away from individual support to the exploration of support within the context of a discipline or programme for a particular cohort. There are advantages including greater efficiencies achieved by targeting students together; the embedding of mathematics support within disciplinary curricula; and increased visibility and attractiveness to students. Such a move represents an evolution of the models of mathematics support and indicates how mathematics support is responding to disciplinary needs within the context of institutional provision, but as consequence means that it is no longer necessarily focused upon the individual which can have negative impacts for some learners. Numerous studies highlight the value to students of personalised and one-to-one support available in drop-in centres but not available in a tutorial or lecture environment (Lawson et al, 2003). Moreover, other studies report that students believe many lectures are fast, difficult to follow and allow little – if any – time for discussion. Further, the fact that students might feel exposed to raise questions during

tutorial sessions means that tutorials are considered as risky places, (Solomon, Croft, & Lawson, 2010). Drop-in centres can overcome these difficulties.

By analysing the free text responses, just over 20% of the institutions who responded to the survey indicated that they used approaches to providing mathematics support (excluding online means such as the provision of resources) that were in addition to the traditional drop-in centre model, to deliver their mathematics and statistics support provision. While still a vital part of the provision, mathematics support is clearly diversifying beyond the drop-in centre model alone.

5. Reward and Recognition Within Mathematics Support

The findings from the survey indicate that much of the delivery of mathematics support takes place by staff on contracts other than those classified as 'Academic' (Table 2a). Table 3 shows that although 11 of the 51 responses came from the research-intensive 'Russell Group' universities, they had the lowest proportion of those overseeing mathematics and statistics support who were on academic contracts (just 2 individuals). In fact, 9 of the 13 responses from the University Alliance (a group formed of universities with a particular focus on links with business and industry and applied research) were on academic contracts, and in the million+ (an association for modern universities) this was 4 from 7.

Amongst the Unaligned Universities, 'Academic Related' contracts were the most widely used for those overseeing mathematics support whereas amongst the Russell Group institutions the use of 'Professional/Managerial' contracts was most the most common (5 out of 11 individuals). Up until recently, a number of the universities now classified as 'Unaligned' were members of another grouping, the '1994 Group'. The 1994 Group disbanded in 2013, but represented a coalition of smaller research-intensive universities, thus it appears that research-intensive universities (the Russell Group and 1994 Group) are less likely to have those overseeing mathematics support employed on academic contracts.

Institutional Grouping ➔	**Russell Group**	**University Alliance**	**Million+**	**Unaligned**		**Totals**
Contract Type ➘						
Academic	2	9	4	6		**21**
Academic Related	4	1	1	8		**14**
Professional/ Managerial	5	2	2	1		**10**
Administrative	0	1	0	5		**6**

Totals	**11**	**13**	**7**	**20**		**51**

Table 3: Contract type by institutional categorisation (n=51).

Overall it seems the case that in the majority of institutions, mathematics support, an academic service, is not overseen or co-ordinated by those staff on academic contracts, but rather by those on the myriad of non-academic contracts specified in Table 3.

Participants were asked whether they felt that, as individuals, they had received recognition for their work; examples of possible types of recognition were provided to inform responses and these included include promotion, awards, and conference invitations. Of respondents (Table 4), it was the case that 22 individuals felt they had received some form of recognition for their work and 29 felt they had not. It was the case here that similar proportions of academic and academic related staff felt they had received recognition for their work. For those on academic contracts, examples of recognition included: International awards, student and institutional awards, National Teaching Fellowships, **sigma** prizes, and amongst the 11 respondents, four explicitly referenced their involvement in mathematics support as contributing to promotion success. For those on academic related contracts, a number of references (five) were made to institutional awards associated with the student experience, including those nominated by students directly, but most significantly not one reference here was made to promotion. For those on professional/management contracts, recognition again included an example of student awards, being invited to speak at events and conferences, and professional fellowships.

Contract Type	Within institution	Nationally	Both institutionally & nationally		Recognition	No recognition
Academic	4	1	5		**10**	**11**
Academic Related	6	1			**7**	**7**
Professional/Managerial	2	1	1		**4**	**6**
Administrative	1				**1**	**5**
Totals	**13**	**3**	**6**		**22**	**29**

Table 4: Individual recognition for mathematics support activities (n=51).

The data was further interrogated (Tables 5a and 5b) to explore if recognition was in any way related to the length of time individuals had worked in mathematics support, either within their current institution or elsewhere, or whether this might be linked to clear governance and regular reporting processes being in place for mathematics support within the institution, for example a steering or advisory group or written reports to senior management. This latter aspect was felt to be important because as one survey respondent commented in relation to them receiving recognition for their work:

"Not really, our senior management are not particularly aux [sic] *fait with what maths support is about."*

Although not universally true, for those receiving recognition for their work in mathematics and statistics support, it does appear that this is linked to working in this area for a period of five years or more, and perhaps reflects the time period needed in order to collect evidence to support a submitted case for recognition or 'catch the eye' to be nominated for recognition. For those who had received recognition despite only being in the role for less than a year, this was typically related to institutional teaching awards and prizes, many of which were identified as being nominated by students.

Length of time working in mathematics support →	**Less than five years**	**More than 5 years**		**Totals**
Recognition ↓	6	16		**22**
No recognition	18	11		**29**
Totals	**23**	**27**		**51**

Table 5a: Individual recognition for mathematics support activities (n=51).

In exploring whether recognition was in any way related to governance and reporting processes being in place (Table 5b), there is a clear trend: where governance and reporting arrangements were in place for mathematics support, two-thirds of staff had received recognition for their work; where such arrangements were not in place recognition fell to just over 20%. Such a finding is likely to be linked not only to the visibility of mathematics support amongst senior management, but also that reporting is likely to involve the provision of data and evidence demonstrating the impact of mathematics support upon both individuals and cohorts of learners. As such, there are personal benefits for those working in mathematics support to ensure clear and regular reporting arrangements to senior management are in place, but also for institutions themselves where mathematics support can provide vital evidence of their commitment to enhancing student learning and success (Tolley and Mckenzie, 2015).

Are governance/reporting arrangements in place for mathematics support? →	**Yes**	**No**		**Totals**
Recognition	16	6		**22**
No recognition	8	21		**29**
Totals	**24**	**27**		**51**

Table 5b: Individual recognition for mathematics support activities (n=51).

In their responses, a number of individuals commented that recognition for their work came from being able to engage with national (and international) activities related to mathematics and statistics support. Opportunities for recognition are also afforded by being able to develop provision within institutions, and through the collection of evidence and data that individuals can then use to either develop their roles or in support of any recognition-based promotions case. In order to do this, staff need to feel that they have a level of autonomy, are supported by their line-managers to engage in national activities, and are able to participate in professional development opportunities. Table 6 explores this aspect of the survey responses.

Overall staff working in mathematics and statistics support feel that they have a high level of autonomy, and this applies regardless of contract type or length of time within their current role. Perhaps most surprising are the responses for administrative staff who indicate high levels of autonomy where it might instead be expected that there would be a greater level of management supervision/direction of their activities. This may reflect the fact that such individuals are undertaking roles that extend beyond the scope of what might reasonably classified as 'administrative'. Interestingly it was academic staff who, on the whole, felt they were less supported to engage with national activities associated with mathematics and statistics support. While this may correlate with the fact that, for this group, mathematics and statistics support was highlighted as only a small component (typically less than 0.1FTE) of their wider institutional role, it might also be related to who they are comparing themselves with. For example, academic staff working in mathematics support might perceive their colleagues working in disciplinary research have much more autonomy over their academic endeavours; similarly, for administrative staff working in mathematics support, they may perceive themselves to have far more autonomy in their activities than their colleagues working in more 'traditional' institutional administrative roles.

In other groups, staff felt they were well supported to engage with national activities, which is a positive development. Previously there were externally funded networks (for example those of the Higher Education Academy Subject Centre Network, the National HE STEM Programme, and most recently the **sigma** Network) that sought to encourage such collaborations through workshops, events and small-scale funding, however funding for these networks has now ceased. Within England (and possibly other nations), the move towards greater scrutiny of higher education institutions' commitment to enhancing teaching excellence continues (DfE, 2017). This creates an incentive within institutions for their members of staff to engage more widely in order to identify effective practices and approaches used elsewhere that they may in turn adopt and adapt in order to enhance their own institutional offer.

	Autonomy				Professional Development				National Engagement		
	S	N	U		S	N	U		S	N	U
Academic	12	6	3		13	3	5		12	2	7
Academic Related	7	3	4		11	1	2		10	4	
Professional/Managerial	8	2			8	1	1		8	2	
Administrative	5		1		4	1	1		4	1	1
Totals	**32**	**11**	**8**		**36**	**6**	**9**		**34**	**9**	**8**

Table 6: Extent to which management supports staff. Note, scores are grouped into 'supported (S)' (scores 4 and 5), 'Neutral (N)' (score 3) and 'unsupported (U)' (scores 1 and 2) (n=51).

This was further validated when the views of respondents in relation to the extent to which they felt supported to engage in professional development activities were considered; overall staff felt supported to engage with such opportunities. Interestingly where there was less perceived support, this appeared to be from staff who have been involved in mathematics support for the greatest length of time, even though such staff generally indicated they had a high level of autonomy within their roles. This may potentially flag a much wider issue, that is one of continuing professional development vs. initial professional development. It is possibly the case that staff who have been in their roles for a longer period receive less attention (other than perhaps an annual development review), or that the provision that is available to them is not sufficiently focused in order to meet their development needs. This in itself aligns with a broader issue observed in UK higher education, particularly for 'teaching-only' or 'teaching-focused staff', as to how such individuals can develop within their roles (Locke, 2014).

6. Who Else Delivers Mathematics Support?

From the results of the survey it is evident that mathematics support is extensively offered within institutions, that is, provision is available for more than 10 hours per week in the majority of cases (Grove et al, 2017). Yet Table 2 highlights that for a number of institutions the staff members responding to this survey would not, on their own, be able to deliver such a quota of support, and further, issues were noted by some respondents in relation to the capacity of their institutions to provide specialist statistics support:

> *"Statistics support is offered during a specific drop-in session (due to a lack of statistics tutors) and appointments are available upon request."*

This gives rise to a valid question - who is involved as the delivery of mathematics and statistics support to learners within institutions? The results from the survey are shown within Table 7.

Yourself	32

Academic colleagues from a single discipline	15
Academic colleagues from a range of disciplines	1
Academic related colleagues	9
Postgraduate tutors	25
Undergraduate tutors	6
Visiting/sessional/hourly paid tutors	11
Other	4

Table 7: Those delivering mathematics and statistics support within institutions. Note, respondents were able to tick all that apply.

Table 1 shows that 22 out of the 51 survey respondents have mathematics and statistics support as the only component of their role, and there were instances of a small number of (either full-time or part-time) staff employed to solely provide this support:

"There are 2 of us who are part time maths tutors…."

"There are two of us employed as Maths & Stats tutors. This is our primary role."

In other cases, academic staff from departments had a key role, although in three instances where this was the case, mathematics and statistics support was restricted to students from particular disciplines. What is most striking from the survey is that there were 19 individuals who were involved in overseeing or managing mathematics support activity within their institutions but who had no role in delivering provision to learners; conversely there were 5 individuals who indicated that it was only they themselves who provided this support, and in four of these instances, the mathematics support was available to all students within their institution.

A prominent feature evident from the survey is the reinforcement of the key role that postgraduate students (almost 50% of institutions) play in the provision of institutional mathematics support, and the evidence that in a limited number of cases (12% of institutions) undergraduate students also have a role:

"One academic, from a rota of 5 lecturers in [removed] *with particular expertise in quantitative analysis in their research and core teaching, leads the weekly drop-in. This is supported by one PhD student at busy times of year."*

"Mostly staffed by main grade lecturers from the maths dept. and maths/stats PG students (MSc and PhD)"

"[removed] *is staffed by the Engineering Maths lecturers at all times. If it is very busy we may have additional help from the engineering peer tutors - 3rd and 4th year engineering students who help in tutorials."*

Delivering mathematics and statistics support is a challenging form of teaching and as such, training for those new to working in this environment is vital (Croft & Grove, 2016). With many institutions using postgraduates, and in several cases undergraduates, to provide support, respondents were asked whether their institutions provided some form of training to those new to working in this environment. Of the 48 responses received to this question, 25 said they provided some form of training versus 23 who said they did not. For those who did not, the reasons given indicated it was due to delivery being by a small team that had not yet grown, or because "*we only use academics and experienced peer tutors*". However, there was recognition within these institutions that training would be considered if needed in the future:

> *"Not yet. We are a very small team but this is something that we would be interested in as we grow."*

> *"We would but we haven't needed to as all our maths support staff have either worked here for a long time or have provided maths support at other institutions."*

But even where engagement with such training would be supported, tutors have not always taken this up, which may indicate training is not always compulsory:

> *"I have encouraged the tutors to join SIGMA and flag up any training they spot. I would support them doing this, but so far they have not taken it up"*

For those that offered training to new tutors, a common feature (seven responses) was the engagement with the provision that **sigma** has offered (see Croft & Grove, 2016) over the last five or six years to support postgraduates, in particular, involved in mathematics and statistics support:

> *"Sigma supported training is required of all maths support tutors."*

Some institutions chose to complement this with their own provision, and examples were noted of good practice in ongoing mentoring and training support:

> "*It is training based around the sigma guide, but we also run a mentoring scheme (informal) where we pair tutors to help people develop experience. Former tutors, who are now staff members also help out with this."*

> *"Training is provided via Sigma Network, induction and on the job training using real examples of students' problems."*

Others offer their own institutional training and mentoring programme, but for some, this appears to only consist of a short or informal briefing:

"A brief and simple induction."

"Very short briefing/debrief session only."

On the basis that postgraduate tutors are selected and appropriately trained, their involvement in mathematics and statistics support has benefits (Croft & Grove, 2016): having been recent graduates themselves, perhaps even within the same institution, postgraduates should not only have empathy with the students who attend, but may also have familiarity with the aspects of the mathematical curriculum with which a certain cohort may struggle. As individuals, they develop a range of transferable skills that will place them at an advantage when seeking employment or an academic career. Further, they may also potentially represent the 'next generation' of staff members who choose to develop a career in mathematics and statistics support.

7. Sustainability

Grove et al (2017) noted the sustainability of the community-wide approach to mathematics and statistics support developed over the last 20-years as existing in two parts: the practice and provision of mathematics support as led by higher education institutions, and the scholarship of mathematics support as led by the individuals who work within it. While this earlier work considered the institutional aspects of sustainability by considering seven of Grove and Pugh's (2017) 10 indicators, here we extend this analysis by exploring their remaining three indicators, relating to sustainability through the influences, activities and scholarship of the individuals involved in mathematics and statistics support.

7.1. Dissemination and Developing a Community Identity

Dissemination forms an important part of the scholarship of teaching and learning. Further, it is very much linked to 'having a story to tell' and so aligns with the needs to 'evaluate' and 'research' one's own practices and their impacts and contributes to engaging individuals as part of a wider scholarly community (hence here we choose to consider these two indicators together). Through the survey (Table 6) it was evident that many respondents felt they had autonomy to engage with the national activities associated with mathematics support, many of which have been established through the work of **sigma** (Croft et al, 2015). This has been very much borne out by the engagement of individuals with **sigma** events and workshops (see for example **sigma**, 2015).

There is the existence of an active and visible mathematics support community which has been fostered through the support of **sigma**. Respondents (Table 6) reported they had a high level of autonomy to engage with national activities, and the value offered by the existence of such a community has been noted by senior management themselves:

> *"The overwhelming majority of those interviewed recognised the value of some level of national collaboration in respect of mathematics and statistics support. At the most basic level, this provides for sharing of resources and experiences to help avoid 're-inventing the wheel'."*
>
> Tolley & Mackenzie (2015)

While financial support for **sigma** ceased at the end of July 2016, substantial effort has gone into establishing a sustainable network building upon the activities of the last 10 years. A national steering committee is now overseeing the future work of this network, and contains wide representation from across the higher education sector. This model for a practitioner network has proved particularly successful in both Ireland (including Northern Ireland) and Scotland with the active and visible Irish Mathematics Learning Support Network (Mac an Bhaird, 2011) and the Scottish Mathematics Support Network (Ahmed et al, 2011), members from which have been particularly active in working with colleagues on mathematics and statistics support activities in England and Wales.

In addition to disseminating through conferences and events, which in themselves are key mechanisms by which an individual can build collaborations and become part of a network, disseminating through publication is key to helping an individual develop their academic identity. Most recently, in the restarted journal *MSOR Connections*, originally published in the UK by the Higher Education Academy Maths, Stats & OR Network, of the 25 papers and case studies published in 2016, 10 were focused upon mathematics and statistics support. It is also interesting to note that of these 10 papers, five were collaborative between institutions.

For many years those working in mathematics support have collaborated on joint activities and through sharing their ideas; increasingly these individuals are making available the outcomes of their scholarly endeavours to enhance the collective literature-base for mathematics and statistics support. The evidence collected to date demonstrates that while the visibility of mathematics support continues to grow, there remains a need for caution. While staff indicate they feel they have a level autonomy to develop their role, many working in mathematics and statistics support are on contract types other than those classified as 'Academic', and as such, do not have the contractual arrangement that allows them the same level of freedom as academic colleagues to explore their own research and scholarly interests.

7.2. Professional Development and Recognition

For those working in mathematics and statistics support and responding to this survey, just over 40% indicated they had received some form of recognition for their work, over 60% felt they had autonomy within their role, and almost two-thirds felt supported to engage with national activities in mathematics and statistics support. The ability to develop one's role as well as to engage with national communities of practice are both important for achieving

recognition and visibility for one's work. Similarly feeling supported to undertake some form of professional development activity was indicated by over 70% of respondents; however, for this to happen, it is important that appropriate development opportunities are available. These opportunities do not necessarily need to be 'formal' or 'accredited'; equally important are the development opportunities where individuals can come together to share ideas, discuss their work, and develop their own collaborations.

Delivering mathematics support can also have an important role in developing postgraduate tutors who may be seeking to pursue a future academic role by providing valuable teaching and student support experience. Such individuals need to be appropriately trained and subsequently mentored. Through **sigma** a national and collaborative model for training postgraduate students has been established (Croft & Grove, 2016), and it is evident from this survey that postgraduates have a crucial role in the delivery of mathematics and statistics support provision. Further, this model of postgraduate support developed by **sigma** has been adopted and adapted within Ireland for use across all institutions who offer mathematics and statistics support (Fitzmaurice et al., 2016).

More broadly, the evidence indicates there is increasing recognition being given for mathematics support, and students, whose nomination awards were cited as a key form of recognition by those working in mathematics support, are likely to have a greater say in articulating what they regard as effective teaching practices in the future (DfE, 2017). In this regard, and in particular through the 'student voice' there are further positive signs for the sustainability and visibility of mathematics support within UK higher education.

8. Conclusions

Grove et al (2017), which presented the results from this survey related to the (infra)structural aspects of mathematics and statistics support provision, validated the findings of Tolley and Mackenzie (2015) by showing that mathematics support is not only widely available to students from a range of disciplines but also that it is being increasing aligned with other institutional student-focused services, and that mechanisms are increasingly in place for universities to utilise their findings and experiences from offering mathematics support to feed into main-stream teaching and learning. There is further evidence of the strategic approach to the delivery of mathematics and statistics support as the survey presents evidence of those working within mathematics support using multiple delivery models to target and engage identified cohorts of learner.

Historically mathematics support has primarily focused upon assisting students from disciplines other than mathematics in developing their knowledge and skills. There is evidence that specialist mathematics students, including those in their later years of study, are now availing themselves of mathematics support. In addition, there is also evidence of both staff members and postgraduate students also accessing mathematics support,

particularly in relation to statistics. While supporting such students is in no way a universal feature of the provision surveyed here, this clearly is an interesting extension to the role and remit of mathematics and statistics support as originally envisaged which needs careful consideration and management. It poses new challenges relating to understanding the motivations of such students for accessing the provision, managing their expectations once they arrive, and in providing support for what might be quite specialised and technical queries. While it may be the case that these students are struggling, it may also be the case that these students are already doing very well but are seeking to improve even further.

Tutors, be they members of staff or postgraduate students, are vital to the success of mathematics support. In considering the conclusions from our survey, it is important to do so within the context of the conclusions from Locke (2014) who explored the changing nature of academic careers. In his conclusion, Locke noted a series of issues requiring attention. These may be summarised as: supporting early career academics; "*the shift to teaching-only contracts and roles, especially where this reduces status and prospects, and restricts the capacity of those who wish to pursue broader academic roles (particularly research)";* helping develop new leaders in teaching; supporting individuals to develop their scholarship, expertise and skills through continued professional development; and, "*enhancing professionalism in teaching and learning in higher education and the research and scholarship that underpins this*."

The staffing associated with mathematics support offers further indication that within institutions mathematics support is becoming an increasingly important student-focused service. Just over 40% of respondents indicated that their role was solely focused upon mathematics and statistics support, either delivery or management (or both), but further the data show that almost 90% of the staff who responded were in permanent roles. Coupled with this trend, however, is evidence of the important role that postgraduate students play in the provision of mathematics and statistics support with almost 50% of centres using postgraduates as part of their delivery approach. Yet while there is widespread recognition of the importance of such training and mentoring, and a willingness to access the national models of support and training currently available, not all institutions currently have training and mentoring provision in place for those new to tutoring in mathematics support.

While there are many positives for those working in mathematics and statistics support, particularly in the level of autonomy staff feel they have within their roles, the ability to engage with professional development provision, and the opportunities to contribute to a national community of practice, there are areas that require further consideration. For example, our survey found that where there was less perceived support to engage in professional development activities, this was from staff who had been working in mathematics and statistics support for the longest time. It must be noted that this may not

be the fault of institutions, but instead may reflect a lack of suitable (subject-specific) development opportunities with which such staff can engage.

Staff working in mathematics support have been particularly active at adding a scholarship dimension to their roles. As noted first by Kyle (2010), there are now an increasing number of academic works relating to mathematics and statistics support being published as part of the learning and teaching literature. With staff in mathematics and statistics support commenting in general that they feel they have autonomy in their roles, many more staff might begin, or further develop, their scholarly practices if given the support, opportunities and (contractual) flexibility to do so. While there have been developments in this area which have been supported by **sigma** (see for example Grove & Overton, 2013), this is an area where a community-wide approach is needed.

Finally, our analysis of the potential for sustainability of mathematics and statistics support is once again very promising. It does indeed show that national practices in mathematics and statistics support are visible and highly likely to continue into the future, both through the provision of higher education institutions, and the practices of those individuals who work in this vital area of higher education activity.

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