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how to set up a mathematics and statistics support provision

Loughborough University

Coventry University

sigma – Centre for Excellence in Mathematics & Statistics Support
Mathematics Education Centre
Loughborough University Leicestershire LE11 3TU United Kingdom
T +44 (0)1509 227460

sigma – Centre for Excellence in Mathematics & Statistics Support
Mathematics Support Centre
Coventry University Coventry CV1 5FB United Kingdom
T +44 (0)2476 888965

National HE STEM Programme

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Authors and Editors
Ciarán Mac an Bhaird (ciaran.macanbhaird@nuim.ie)
Duncan Lawson (mtx047@coventry.ac.uk)

Contributed Sections
Pages 20 to 21: Tim Sparks (ab1638@coventry.ac.uk)
Pages 22 to 24: Clare Trott (C.Trott@lboro.ac.uk)

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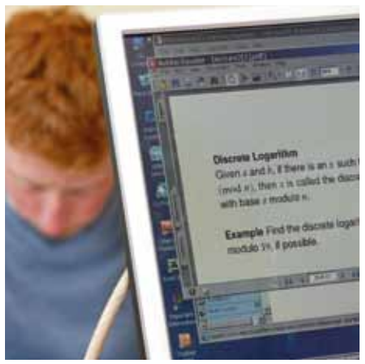
sigma – Centre for Excellence in Mathematics and Statistics Support
Coventry University Coventry CV1 5FB United Kingdom
T +44 (0)24 7688 7688



Introduction

The purpose of this booklet is to act as a guide for anyone who is interested in setting up or enhancing a mathematics and/or statistics support provision. Throughout we will use the term mathematics support to mean a support offered to students (not necessarily students of mathematics or statistics) which is in addition to their regular programme of teaching through lectures, tutorials, seminars, problems classes, personal tutorials, etc. The aim of this support is to improve the performance, especially, but by no means exclusively, of those who are struggling with the mathematical content of their courses.

We will use the term Mathematics Support Centre (MSC) when referring to the specific facility where such mathematics support is provided; this is variously known in different institutions as Maths Workshop, Maths Help, Maths Drop-In, Maths-Aid, Maths and Stats Help etc.

The material is presented in short, stand-alone sections which follow the sequence in which someone at an institution with no mathematics support might proceed in order to establish a MSC.

On page 4 we give a synopsis of why mathematics support is needed in Higher Education Institutions (HEIs), and then on page 6 we present an overview of the extent of current mathematics support provision throughout the UK. This information may be useful in persuading senior managers within the institution of the value of setting up a MSC.

However, information alone is rarely enough to persuade management to set aside resources. For this reason, on page 8, we proceed to discuss the internal relationships that you should build up and maintain within your own institution. At the outset, these close connections can be important for securing initial funding, but once you have started providing support, they will be crucial to the success of many aspects of your provision.

Once management agreement has been secured, it will be necessary to establish the intended ethos of your provision – determining this at the outset is crucial as it will affect how you operate, the nature of training given to staff and the way you publicise your MSC. This is discussed on page 10 along with the nature and location of the support.

Having determined the ethos for your support, its nature (i.e. what support you intend to offer) and where it will be located, the next requirements are: staff to provide the support, students to engage with the provision and resources to be utilised by both the staff and students. On page 13 we discuss who should work in an MSC and what training they require. Methods of promoting student engagement with the support on offer, some of the common difficulties encountered and how they might be overcome are covered on page 15.

The mathematics support community is a highly collaborative one and a huge array of resources that others have already produced is freely available. A summary of some of the better-known and more widely used of these resources is given on page 17.

The material presented on pages 4-18 should be sufficient to enable you to establish a functioning and useful MSC that will benefit students in your institution. The next three sections cover ways in which this provision might be further enhanced.

On page 19 we focus on the student body as a resource. Several existing MSCs have found that by harnessing the energies and insights of students the quality of service and the level of engagement can be significantly enhanced.

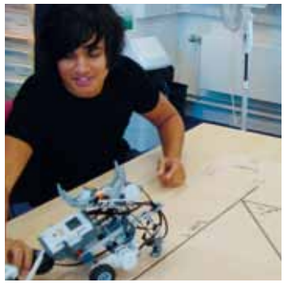
Some aspects of the difficulties students face with statistics can be dealt with in a similar manner to those in mathematics. However, other aspects can be quite different; a particularly frequent example of this is the student who is undertaking a large scale piece of work (possibly a final year undergraduate project or masters dissertation) in which they need to collect and analyse a large quantity of data. Pages 20-21 suggest ways in which statistics support might be incorporated into your MSC.

Some students require more specialised support if they are to succeed. It may be that they have an additional need such as dyslexia or dyscalculia. Or it may be that they are severely 'maths phobic'. Pages 22-24 give suggestions about how support might be made available to such students.

Whatever the extent of your support provision, it will be important that you evaluate its effectiveness. The senior management within your institution will probably demand this; but even if they do not, it is good practice for you to do so in order for you to continuously improve the service you provide for students. On page 25 we consider issues around the effective evaluation of the support provision.

This guidebook builds upon a wide range of existing expertise, so before you commence your new initiative, we also strongly urge you to contact experienced members of the wider mathematics support community and seek their advice. One way to do this is through the **sigma** network (www.sigma-network.ac.uk). Many members of this community have contributed to a number of invaluable reports and papers on various aspects of mathematics support that we frequently refer to in this booklet. Exact details on this material and more are contained in the reference section, but we will list some of the main work here (in no particular order):

- Good Practice in the Provision of Mathematics Support Centres, Lawson, D., Croft, T. and Halpin, M. (2003) 2nd edition, LTSN Maths, Stats & OR Network, Birmingham. Available from www.mathcentre.ac.uk/resources/guides/goodpractice2E.pdf [accessed 10 July 2012].
- Setting up a maths support centre, Lawson, D. (2012) http://sigma-network.ac.uk
- Tutoring in a mathematics support centre: a guide for postgraduate students. **sigma** (2011) Available from www.mathcentre.ac.uk/resources/uploaded/46836-tutoring-in-msc-web.pdf [accessed 10 July 2012].
- Gathering student feedback on mathematics and statistics support provision: a guide for those running mathematics support centres. **sigma** (2012) Available from www.mathcentre.ac.uk/resources/uploaded/sigma-brochure-for-accfeb5-finalv1opt.pdf [accessed 10 July 2012].
- Mathematics support past, present and future. Lawson, Croft and Waller (2012) Innovation, Practice and Research in Engineering Education http://sigma-network.ac.uk



Why is Mathematics Support needed?

A very high proportion of students entering higher education institutions (HEIs) have some components of a mathematical or statistical nature in their courses. There are the obvious subjects such as mathematics, physics and engineering. However, increasingly students of other subjects (such as business studies, biology, economics, nursing and psychology) find that, in order to succeed, they need to be proficient in aspects of mathematics, statistics and their applications.

This continuous increase in the quantitative nature of many degree programmes coincides with a school mathematics curriculum which does not appear to be preparing many students adequately for higher education. This so called 'mathematics problem' has been reported for many years; for example, Sutherland and Pozzi (1995) report on the particular problems faced by engineering undergraduates and Sutherland and Dewhurst (1999) studied the problems faced by a wide range of disciplines and in a range of universities. The 2000 report by Savage and Hawkes draws attention to the significant and measurable decline in students' basic mathematical skills even amongst the better qualified students of mathematics. Lawson, Croft and Waller (2012) give a detailed overview of the history of the 'mathematics problem'.

Recent major reports highlight the current scale of the problem, for example, the Vorderman report (2011) concluded that mathematics education is in crisis and called upon the Government to designate it as 'a subject of critical importance'. This followed work by the Nuffield Foundation (2010) and the Advisory Committee on Mathematics Education (ACME) (2011) which reported that inadequate numbers of students were taking mathematics after the age of 16. The ACME report states: *"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. At the moment fewer than 125,000 have done so."*

In 2012, the RSA report 'Solving the maths problem' asserted that "English universities are side-lining quantitative and mathematical content because students and staff lack the requisite confidence and ability". The 'mathematics problem' may have been known about and discussed for many years, but despite the title of the RSA's report, it is clear that it has not yet been solved.

Mathematics support has developed as one measure to try and address the problem. Lawson, Croft and Waller (2012) give an overview of this growth which has seen mathematics support become established as a successful form of support for students across all disciplines. Though it initially focused on retention, it quickly and organically moved beyond improving retention rates. Many better students now use it to improve their grades, and support has expanded beyond its original remedial function.

The impact that mathematics support is having on HE should not be underestimated. Students are the main benefactors of mathematics support activities, and the establishment of best practice in the wider community has been shown to improve students' university experience and their understanding of the mathematics and statistics they need for success in their courses.

During difficult times for mathematics education in general, where negative attitudes are commonly reported on, it is notable that student evaluations of mathematics support frequently report positive attitudes towards the subject, students are more enthusiastic about mathematics, more confident in their abilities and they often report on the friendly and enjoyable atmosphere that mathematics support centres provide as the norm. Evaluations often also highlight increased retention and progression rates as a result of student engagement. Mathematics support is clearly not the only solution to the 'mathematics problem', but it is a proven part of the solution at many HEIs.

It has been recognised by many HEIs that they should be taking the initiative to tackle the problem as it manifests itself within Higher Education. The 2004 National Inquiry into Post-14 Mathematics Education (the Smith Inquiry) concluded that "higher education has little option but to accommodate to the students emerging from the current GCE process" and the 2008 report of the Public Accounts Committee urged universities to improve retention by providing "additional academic support for students, for example those struggling with the mathematical elements of their course". The need for mathematics support initiatives still remains high.

A recent study by Perkin, Lawson and Croft (2012) has shown that the level of mathematics support provision in UK HEIs is now above 85%. Clearly the importance of such provision is being recognised by many institutions, and there is clear evidence that mathematics support is being embedded as part of the normal service that any student should expect within a HEI. Many students come to university with a dislike or fear of mathematics and statistics, and they often have very low confidence in their abilities in these areas. Mathematics support is proven to provide a friendly non-judgmental environment for these students to allow them to fulfill their potential.

Key Points

- Significant numbers of students are entering higher education lacking the mathematical skills they require to deal competently with the mathematical content of their courses. This affects a very broad range of disciplines including, increasingly, the biological and social sciences.
- This 'mathematics problem' remains a major issue despite being reported on for many years.
- It is widely recognised that HEIs should take the initiative to try and deal with the mathematical issues of their incoming students.
- Mathematics support has grown substantially in the past 20 years as an effective and popular vehicle through which many students can deal with these issues.

The National Picture

Prior to establishing your own mathematics support provision, you should access the recent report (Perkin, Lawson and Croft, 2012) *Mathematics Learning Support in Higher Education: the extent of current provision in 2012* which is available from the **sigma** network website. As well as an overview of the current provision, it gives a snapshot of the range of support that is available across the UK and demonstrates significant growth in the mathematics support community since 2000.

Following a Learning and Teaching Support Network funded study in the UK in 2000, Lawson, Halpin and Croft (2001, 2002) reported that 46 out of 95 responding universities were providing some form of mathematics support. A similar study was undertaken by Perkin and Croft (2004) which showed that 66 out of 101 responding institutions provided additional support, and the 2012 report shows that 88 out of 103 responding institutions now provide such support.

In the 1990s, some individual institutions, such as Coventry University, decided to establish mathematics support initiatives to try to address the mathematical issues of incoming students. During the latter part of the twentieth century and early years of this century, the mathematics support community began to grow. The momentum to expand and promote mathematics support as a normal part of the support that is available at HEIs received a huge boost in 2005, when Coventry and Loughborough Universities were awarded Centre for Excellence in Teaching and Learning (CETL) status and **sigma** CETL was born.

sigma established itself as the leader in the provision of mathematics support both nationally and internationally. Along with expert advice and resources, which help individuals and institutions involved in mathematics support to adopt good practice, **sigma** has run a series of initiatives (initially with CETL-funding and then with National HE STEM Programme funding) which have directly led to the establishment of 17 new support facilities and the **sigma** network of regional hubs across England and Wales which facilitates easier collaboration and communication.

Table 1 (Perkin et al., 2012) compares the three surveys and shows how the percentage of institutions offering mathematics learning support has grown in the past 12 years.

Table 1: Growth in mathematics support activity since 2000

Year of Survey	Number of HEIs providing support	Number of HEIs replying to survey	% Offering Support (as a % of those responding)
2000	46	95	48
2004	66	101	65
2012	88	103	85

(adapted from Perkin, Lawson and Croft, 2012)

The nature of institutions offering mathematics support has also been analysed and the data show that HEIs from all mission groups now provide support (88% or more of the responding institutions surveyed in each of the Russell, 1994, Alliance and Million+ groups had some form of support).

Perkin et al. also report on the range of support available. At one extreme are institutions which have dedicated mathematics learning support centres operated by academic staff and opening, in some instances, seven days per week, whilst at the other are those where postgraduate students offer support for a few hours each week; some support is available to all staff and students, whereas others are only available for specific groups, for example first year undergraduates. We elaborate on these issues on page 10.

Access Agreements with OFFA are another crucial aspect of the current national picture within England. If institutions are charging students fees above a certain level, then they must commit to providing extra support for students. Many institutions are committing to the provision of mathematics support as a result of this requirement. For example, in the Access Agreement for the University of Bath, mathematics is the only subject explicitly mentioned since it is viewed as a barrier for students wishing to study at the university, particularly those with vocational entry qualifications. Many of the Agreements outline mathematics support provision. For example, the University of Salford's agreement states; "Mathscope is a support unit for students experiencing difficulties with mathematics in whatever subject they are studying" and the University of Newcastle confirm that they will "continue the delivery and further development of services that support students' academic skills post entry: Maths Aid and the Writing Development Centre".

Many individuals involved in mathematics support are using their institution's Access Agreement as a way to embed their support within the normal student support infra-structure. The presence of mathematics support in so many access agreements is a factor that can be used to argue for the establishment of support provision within institutions which currently have none.

Key Points

- Mathematics support is now available in the majority of HEIs in the UK.
- You should make yourself aware of the breadth and depth of support available.
- OFFA Access Agreements can play an integral role in the promotion and embedding of mathematics support within individual institutions.

Internal Relationships and Funding

Prior to establishing mathematics support provision, it is crucial that there is institutional support for the initiative, ideally at both senior management and departmental level (departmental level support should be from both the mathematics department, if there is one, and the departments of students who may need support).

As we discuss on page 10, there is a wide range of support that can be offered in any institution. There are many different formats but support typically starts within schools and departments or within the broad umbrella of student services. Some support is run by permanent staff only, and as such, may require little or no initial funding. However, the majority are staffed, at least in part, by non-permanent staff such as postgraduate students and, in these cases, funding is essential.

It is crucial that you communicate the exact aims of your support clearly to all relevant personnel and students in your institution, and when you have evaluated the support available, this information should also be disseminated. We discuss further details of this process on page 15, but, for now, it is important to note that the person who runs the support needs to be clearly visible and viewed as approachable by all staff and students at the institution.

Institutional staff may not be clear on the nature of the support that you are offering; some people may view the provision of additional support as a negative reflection on the standing of their institution, whether through the abilities of the students or the staff. In institutions where there is extensive service teaching, the development of mathematics support may be viewed as a threat by the mathematics department. Maintaining a visible presence will allow you to reinforce that the support offered is a complement to, not a replacement for existing structures such as lectures and tutorials.

As discussed earlier, the 'mathematics problem' is well-documented and mathematics support in higher education is now becoming the norm across the UK. The fact that an institution offers mathematics support can be seen as a positive reflection on the institution: it is putting in extra effort to bring students up to the skill level required to deal with the material they encounter at university, thus maintaining high standards. The fact that so many HEIs now provide mathematics support can reflect negatively on an institution without a mathematics support centre as it may suggest either that they are unaware of the needs of their students or that they are not taking steps to assist them.

The person running the support service should liaise closely with the schools, departments and faculties that have mathematical content in their courses, and thus presumably will have the majority of the clientele. Support initiatives may be independent of schools or faculties or they may be embedded within them. Either way, an open approach and the promotion of the service as an essential part of the student learning experience, which is non-threatening to staff and students, is essential. The people involved should generally be aware of the issues that students are having with the mathematical content of their modules. If a support is viewed positively by a school or faculty, then it is often internally promoted and used more frequently by their students. This close relationship is very successful in some institutions, with certain lecturers and schools or faculties approaching the provider of mathematics support to suggest specific extra support that they would like provided for their students.

There are many key offices/facilities within your institution that should also be fully aware of the support that you offer and its evaluation. These include Teaching and Learning, Student Services, the Students' Union, the Access, Disability, and Mature Students', Widening Participation, Outreach Offices and the University Library. In many institutions, extra support is offered from these offices for specific groups of students. In particular, Student Services, the Students' Union and the Library are key to the promotion of mathematics support in many institutions and they may sometimes have space to provide a venue. Existing student services are often a vehicle whereby the provision of mathematics support can be embedded within the institution.

Establishing a good relationship with both the Admissions and Communications' Offices is also worthwhile. Mathematics support provision is becoming a normal part of the service that institutions are expected to provide to students, and both these offices often use the fact that such support is provided as a way to advertise and promote the institution to potential students. The presence of such support should be attractive to students and parents.

On page 25 we address the issue of evaluating the support that you offer. Not only will it provide the facts and figures on engagement levels with the support, but it can also provide evidence of any impact on student retention and progression; evaluation forms can measure any increase in student confidence and improvement in attitudes towards mathematics. It is important to be on top of this material at all times when dealing with your institution – it is key evidence when seeking a better location, more equipment, commitment to embedding the service within the institution and, most importantly, funding.

If you have accurate data and analysis, the request for funding becomes an easier argument to justify. Mathematics support is cost effective, the main recurring cost is the postgraduate or other tutors, and as we highlight on page 13, staff are your number one resource. The amount of money an institution saves for students who remain on course typically far outweighs the cost of the centre. This highlights again the importance of disseminating your data and analysis to all the relevant funding bodies within the institutions, whether they are centrally based or in departments.

The amount and source of funding will inevitably depend on internal institutional politics. The best advice is to maintain a high profile for the support on offer. Ways to do this include regularly advertising achievements in staff and student magazines, and inviting members of the institutional staff to come and visit the facility and attend any events. In particular, along with all your evaluation, you should publicise stories of individual students who have clearly benefited from the support provided, and ensure that institutional staff are aware that around 85% of HEIs now provide some kind of mathematics support.

Key Points

- Disseminate clearly the aims of your mathematics support provision to all institutional staff.
- Clarify that mathematics support is an integral part of services offered to students in the majority of HEIs in the UK.
- Reinforce that mathematics support is a complement to traditional teaching practices.

The Nature of the Support

The success of a mathematics support initiative depends on the exact ethos of the support provided. The ethos will influence the nature of the provision and the ideal location for the support service. However, practicalities may mean the ideal location is not available and the actual location you have may, in turn, influence the nature of support.

Ethos of Provision

For your mathematics support initiative to succeed in attracting and helping students, it must be welcoming, supportive and non-threatening. No question should be viewed as too basic, and it should assist all students, not just those who are struggling with the basics: there is a place for those trying to turn a fail into a pass and also for those who want to improve an upper second into a first. When considering the establishment of mathematics support, or if you are reviewing an existing provision, there are a number of important issues that you should address before you start. These are reviewed briefly here, but a more detailed discussion of these issues can be found in Lawson, Croft and Halpin (2003).

The first questions you should ask yourself are 'Why are you setting up the support?' and 'What is its purpose?'. Most types of support have similar objectives: they aim to give non-judgmental support to students with any mathematical difficulties in a relaxed and friendly environment.

The next common question to ask is 'Who can access the support?'. To a large extent, this depends on how and why the support was set up initially. The support may only target a specific group of students. A more common and more inclusive approach is that any student taking a mathematics or statistics module (or indeed any module which includes some mathematics or statistics) can use the support available. In many ways, the ideal situation is that the support is for all students (and sometimes staff).

Experience of good practice throughout the sector indicates that support centres develop this all inclusive approach gradually, based on the level of demand from both staff and students and from evaluation. However, internal politics and funding issues can also be a major factor in this decision.

Any decision to broaden the availability of support needs careful consideration as it will invariably lead to an increase in both the numbers of people accessing the support and the range and depth of material that will be asked about. This can have a big impact on both the number and expertise of staff that are required. Some queries can be very advanced in nature and lead to a disproportionate drain on staff time and centre resources. These situations need to be carefully managed as they can lead to a decrease in the engagement levels of the students for which the support was initially established. It is important to set goals that can realistically be achieved with the funding and resources that are available and then to manage expectations through clear statements of the kind of support that is provided and for whom.

It is all a question of balance, and different institutions cope in different ways. In some institutions help is limited to those most in need of support, usually foundation and first year students. Alternatively, help may be offered to anyone in the university but limitations placed on the range of help provided; possibly advanced topics may not be covered or are only dealt with at certain times and by certain staff. However, the imposition of limitations on who can use the centre (especially if this is after it was available to anyone) can undermine such a supportive and non-threatening atmosphere if not dealt with appropriately.

The overall ethos of a support is key to its effectiveness, and the clear and visible intention should be to create a non-threatening, positive and supportive atmosphere for all users.

The Nature of the Provision

Once the aims of the support have been established, the next main decision is what type of support will be offered to students so that the aims are achieved. There are many different strategies used in different institutions, but as mentioned already, they generally share common goals. Lawson's (2012) report on 'Setting up a Maths Support Centre' gives a thorough overview of the situation. Of particular interest are the five case studies which were selected to illustrate how mathematics support is being provided across a variety of situations and institutions. The case studies featured were: the large well-developed support centre at Coventry University, the peripatetic Maths Cafe at Portsmouth University, the University of York (where a dedicated member of staff works closely with the mathematics department), the University of Kent (where the support provision is mainly delivered by PhD students from the mathematics department), and the University of Lincoln (which has no mathematics department, and support is delivered from a central unit).

The component of mathematics support most commonly reported as highly valued by students is one-to-one help, and access to this attention from staff is seen as an incentive to attract students to use the centre as a place of study. One-to-one support is usually organised in one of two ways: by pre-booked appointments or on a drop-in basis. Though the drop-in model is more widespread, there are advantages and disadvantages to both options, and their success can depend on the institution and the number of students who engage.

An appointment system can be very effective, students know that they will get help at a particular time, and staff know exactly when they are or are not needed. One hurdle to such systems is the administrative overheads of managing the appointments schedule; however several institutions are now using their Virtual Learning Environment (VLE) to manage the appointments automatically. Another issue is that the appointment system becomes problematic if it is oversubscribed causing students to have to wait several days (or even longer) to receive help.

Using a drop-in centre for one-to-one support can address the issue of long waiting times, but there will inevitably be peaks and troughs in attendance levels, and these times can be difficult to anticipate. During the troughs the tutor may be left with nothing to do, waiting for someone to come and ask for help. During the peaks, there can be so many students in the centre seeking help from the tutor that some give up after they have been waiting for a long time without being seen. One possible solution is to get the students into groups working on similar issues. This can be very effective, it encourages collaboration and peer tutoring, which has many benefits. However, it is also moving away from the one-to-one model which many students prefer.

Another alternative approach is to offer a series of workshops on fundamental topics; these topics can be chosen by the support staff, academic staff or indeed by the students themselves. The timetable for these workshops (including topics to be covered as well as times) can be published in advance so that students can attend those workshops which are relevant to their particular weaknesses. Some institutions post the notes from these workshops onto their VLE, and also include relevant online resources. Some institutions are also using their VLE to provide online support on basic materials. This can be a very effective use of staff time and resources; however engagement levels (page 15) are sometimes low.

It should be noted that none of the above approaches are mutually exclusive and it is perfectly possible to offer a combination of them. However, when you commence the provision of support, it is sensible to adopt one approach and then grow organically to offer an appropriate range to meet the needs of your students. Many institutions offer a mixture of support, providing some drop-in one-to-one help, pre-booked appointments and workshops. Inevitably, the range of what can be offered is limited by the available funding, the number of staff, and possibly by the location of your support.

Location of Provision

The best location for the support offered depends on the nature of the support provided. The majority of mathematics support is delivered through one-to-one or drop-in help provided by tutors. The location of this provision is usually fixed in certain venues. Thus the main issues, if you have a choice on the venue, are where the centre should be situated, and whether or not the room is used exclusively for mathematics support provision. In any situation, you should insist that the location be furnished appropriately; it should be comfortable and welcoming for students and staff alike. Relevant resources (see page 17) should also be available.

If your support is offered to anyone in the university, then centrally located and popular buildings are typically the best location, e.g. student services, Teaching and Learning Centre or in the Library. This is true of fixed or portable initiatives: some portable style support use several central locations including student cafes and are very successful. If you are helping only specific groups of students from certain schools or departments, then it makes sense to be situated somewhere convenient for these students; typically you will need a smaller space and this can be sometimes be sourced within the targeted department. Regardless of the location, as mentioned on page 15, it is important that the venue is well advertised and that students know exactly where it is.

If you secure a suitable location, you may not be the venue's sole user and this can have an impact on the effectiveness of the centre and the range of support you can offer. While dedicated rooms are the ideal situation, for many this may not be possible – particularly at the start of a support initiative when the centre may only operate for a few hours per week. In these situations, tutors are the main resource and at the very least, you should insist on secure storage, such as lockable filing cabinets, where you can keep extra resources (page 17). If the venue available is not ideal, then your records and student evaluations (page 25) can provide important evidence in trying to secure more suitable facilities.

Some institutions have a dedicated room where it is easier to control both the layout and resources made available to students. One option that you could consider in this scenario is to open the venue as a place for students to study outside of the hours that a tutor is present. This encourages appropriate group work, and promotes the idea that the centre is a place for study where staff support is available at certain times. An interesting insight into this group dynamic is contained in Solomon, Croft and Lawson (2010).

Key Points

- The ethos, nature and location of the support you provide are closely related to each other.
- The support you provide should aim to help any student, regardless of ability, in a friendly, welcoming, supportive, non-threatening and non-judgmental atmosphere.
- You should make yourself aware of the range of models used in mathematics support, in terms of the services offered and to whom they are offered.
- Striking a good balance in the services that you provide is essential to meet the needs of your students.

Staff and Training

The staff who provide mathematics support are without doubt the number one resource that you will have, and they are highly influential in the success (or otherwise) of the provision. Staff are often the first and main experience that a student will have with the support provided, so it is key that staff can deal with these situations appropriately and professionally.

Training is the key to this success. Different approaches use a variety of staff, including academics and postgraduates or part-time staff. Some institutions use undergraduate students as peer-mentors or peer-tutors, and others use dedicated MSC staff, such as former teachers or further education lecturers who are employed on a part-time basis.

There are many reasons for the range of staff that are used; these can depend on the individual institution and funding is often an issue. Academic staff tend to be the most knowledgeable, however not all academic staff are suited to a support environment.

Former teachers or education lecturers usually have, from previous experience, a good grasp of the mathematical backgrounds of the students coming for help. Undergraduate or postgraduate staff, as opposed to permanent staff, can be considered more approachable by students. However, one disadvantage is that most undergraduates and some postgraduates will have little, if any, experience of teaching and are unlikely to have the breadth of knowledge to offer help in the full range of areas in which it is sought.

It is also important to stress that MSCs do not expect their staff to be experts on absolutely everything that students may ask. If a student comes in with a query in an area that staff are not familiar with then they have two main choices:

a) Admit immediately to the student that they are not familiar with this material and suggest a specific time when the student might come back and find a member of staff who can help with this (this obviously requires the member of staff to be familiar with the expertise of others) – one option, that some MSCs employ, is to show (on noticeboards inside and outside the MSC and on the website) a timetable indicating the skills (in broad areas) of the duty staff. Some MSCs list the staff who are familiar with the main modules that students tend to ask questions on.

b) Admit that they do not know much about this but work with the student, using his/her notes and/or books and online resources to try to come to an understanding of the topic – this can be useful for the student in that they see that even 'good mathematicians' do not know everything and they also see the process of how someone goes about understanding something they are not familiar with. In the event that the tutor is still unable to help, a useful strategy is to assist the student in formulating specific questions to take back to the lecturer concerned. For example, 'Can you explain the meaning of this symbol?' or 'How does this line follow from the previous one – is there a particular result I am missing here?'

Support should be provided in a non-judgemental atmosphere where students are comfortable with asking any question. The impact that staff have in the promotion of this environment is highlighted by the number of times that they are mentioned in evaluations. The majority of comments are positive; however students mention the importance of having high quality staff with particular skills. The key point made is that building students' confidence is of huge importance and this requires staff who are patient and accepting. If a student engages with the support and goes away with the impression that their questions were regarded as stupid or trivial, then they are unlikely to return for further help. Furthermore, if this perception (whether

valid or not) spreads, it can have a very negative effect on engagement levels and it will be difficult to alter this impression once it is created.

In addition to the issue of who should staff the centre there is also the question of how many staff are required. This depends on both the nature of the support that you are providing, and on student demand. Some centres can get very busy and waiting times for students can increase significantly. It is important not to react too quickly to spikes in activity; they may just be one off events – such as an imminent coursework hand-in deadline.

However, if a pattern emerges, then it is important to take some steps to try to accommodate the uneven demand. Some centres ask their staff to organise students into groups, to encourage appropriate collaboration and to try to increase the effectiveness of the support provided. Also, students should be encouraged to make good use of the resources available in the centre such as help leaflets and books. If the overcrowding or understaffing becomes a continuous issue, and there are no additional staff available to you, then you need to use your data and evaluation to try to address the issue, whether through the provision of alternative support (such as workshops to address common student issues) or by seeking extra funding for further staff.

Whatever type and number of staff are used, it is crucial that they are given a good induction into the ethos of the centre so that they promote, rather than inhibit, the growth of a safe, non-threatening atmosphere. Suitable and conscientious academic staff do not require much training, however postgraduate and part-time staff will require training.

In order to train your staff appropriately, you should check out the **sigma** guide 'Tutoring in a mathematics support centre: a guide for postgraduate students'. This is a very thorough and effective guide, which shares not only the expertise of experienced mathematics support practitioners, but it also contains activities which can be used during tutor training sessions. This material is available from the **sigma** Network website. If you contact the co-ordinator of your local **sigma** regional hub, they should also have information on experienced members of the community who would be willing to assist in or direct a training session. There are several people involved in the **sigma** network who are experts at providing training opportunities. Some hubs also organise central tutor training sessions which can be attended by individuals from institutions across that region.

Staff involved in providing support should give a good impression; they should be friendly and engaging and allow students to feel comfortable. Many incoming students are nervous or afraid of mathematics, so your staff are the standard bearers in promoting the service as a friendly non-judgmental support which allows students to become more comfortable with mathematics and get to where they want to be, whether it is a pass, or an improving grade.

Key Points

- Not all staff are suitable for mathematics support, but professional and appropriate staff are essential to your success and they are your number one resource.
- All staff must understand the nature of mathematics support provision, and be able to engage with students in a manner that aligns with the ethos of your centre.
- Make use of the existing range of expertise, workshops and training booklets when organising and implementing your staff training.
- Staffing levels depend on the support being provided, engagement levels and funding. Recording all activity in detail will assist you in addressing these issues.

Student Engagement and Publicity

One measure of the success of any support provision is the level and quality of student engagement. There are certain aspects of this engagement that you can directly control, such as making students aware of the service through publicity and ensuring the highest quality of service when they attend (see page 13). Unfortunately, evaluations often show that many students who are most in need of the support do not access it. This is not directly within your control, however some MSCs have taken additional steps to try to effectively target these students as well.

Advertisement and publicity are essential for any support initiative, and these can be carried out both inside and outside of the venue where support is provided. The content and layout of the adverts are also very important, and there is a strict balance between too much and too little information. They should all contain basic information such as venue, opening hours and services provided. There are a number of traditional routes used for advertisement outside the centre such as websites, posters, flyers and bookmarks to which some centres add photos, cartoons, or quotes to make the adverts more interesting. The advertisement should also be placed in strategic locations across the institution such as in the library, student services, counseling services and in the relevant departments/schools.

Other centres also place articles or adverts in student magazines, they email student groups, liaise with Student Services and/or the Students' Union, they make announcements in lectures and tutorials, and many give induction week presentations or organise student visits to the venue. Publicity events where students get to meet someone representing the service are also quite influential, as they are an opportunity to ask questions and address any concerns right from the beginning. This is a role that student ambassadors (page 19) often fulfill very successfully. Recommendations to students from teaching staff, from personal tutors or other staff in the institution (e.g. student services) are often the most effective form of advertising, so it can be a good idea to address publicity to staff, perhaps before induction week and make yourself available to answer any queries that they have on the service. Assuming that you have developed good relationships with colleagues in the departments where students are likely to come from (as discussed on page 8), then securing this buy-in to the publicity process should be straightforward.

It is also important to have clear signage close to the venue or venues where the support takes place; it needs to be clear to all students where the centre is located. If there is a dedicated venue, then it may be possible to secure a notice board outside which can contain all relevant information such as opening hours, staff, services etc.

Many centres forget that advertisement also takes place within their facility, and this may be the most influential publicity a centre can have. When students access the support offered, the way they are treated by staff (page 13) is crucial. If students are welcomed to an informal relaxed venue, with friendly competent staff who treat them with respect, then they are likely to return and also tell their peers.

Staff should also be encouraged to ask students when they will return for their next visit, enquire how their friends are getting on with the material, and suggest maybe that they could bring some of them next time. Some centres, if they have the space, find that the most effective way of encouraging student engagement is to promote the use of the venue as a general study area where additional help is available. If students develop the habit of working in the room because it is a pleasant, convenient location, then they are in the right place to receive extra help when they need it.

Despite the range in advertisement and publicity outlined here, one of the main concerns of any support initiative is getting the students who are most in need to use it. Some people will argue that this boils down to students taking the responsibility for their own learning, and that we are already doing enough. However, taking those extra few steps, though often time consuming, can really make a big difference to some students who would otherwise almost certainly drop out. Even though each additional new initiative aims at increasing uptake amongst more reluctant students and thus becomes subject to the law of diminishing returns, if each scheme reaches and retains students who resisted previous attempts, then ultimately it is worthwhile and is crucial to your argument for continued or additional funding.

There are several approaches taken to increase engagement with support amongst weaker students. A common method used by many institutions is the delivery of diagnostic tests, in which the weaker students tend not to perform very well, and the subsequent assignment of appropriate support, such as one-to-one tutoring, workshops or online resources. However, unless the follow up support is compulsory, engagement levels can remain low. To address this issue, one institution has implemented a monitoring scheme whereby students with low engagement levels are contacted, and it is reported that this has led to a significant increase in engagement levels.

Another effective method of advertisement is the use of the facts and figures, impact and feedback (page 25) of your support. If you have evidence of the impact of appropriate student engagement on grades, confidence, and retention rates, then students often pay attention to what they can view as concrete evidence of the benefits of the support offered.

Mathematics support can provide a range of high quality resources, but if students do not use the resources provided, then the support cannot be deemed a success. We have given a number of pointers on securing student engagement, but almost all centres continue to report problems. The difficulty of securing student engagement should not be underestimated.

Key Points

- The success of your support is measured by the level and quality of student engagement.
- Engagement levels can be improved by an appropriate publicity campaign which clearly projects the ethos of the support available to both staff and students.
- An effective advertisement campaign will include a range of options including posters, emails, class announcements and student ambassadors.
- The students most in need of the support do not always access it; it is worthwhile to take some extra initiatives to try to increase their engagement.

Resources

The resources that you make available play an important role in the day to day running of the support and in its long term success. Essentially, these resources can be broken down into two main categories: 1) staff and students, and 2) physical and online resources. Having students listed as a resource may seem unusual – we elaborate on this in more detail on page 19.

The nature of your provision, which is dependent on the disciplines of the users, can dictate to some degree the balance of the resources that you use. The aims of your support can generally be addressed appropriately by using a variety of resources.

Staff and Students

We discuss both the staffing (on page 13) and the potential use of students as a resource (on page 19) in further detail elsewhere. However, the personnel issue is such an important point, that we want to stress again here that the staff that you use are your primary resource, and for many mathematics support initiatives they are (at least initially) the only resource. In evaluations, positive comments about tutors are typically the most common response from students, and this is also a great source of publicity. If students think that the support does not have good staff, then they will not engage and word will quickly spread.

Physical and Online Resources

Before we begin our description of these resources, we should mention the importance of websites for any support initiative. Initially, it is sufficient to have a basic website, so if students want to find out more about the support, they can access a description of the support on offer, how it works, opening hours, ethos, staff and links to resources. The website should, in time, become another support outside of your opening hours which students can use as a focal point for resources. Many centres also use their institutions' Virtual Learning Environment (VLE) to deliver online materials or online courses.

The physical resources that are most commonly used in mathematics support are printed materials and computers which allow work on Computer Assisted Learning (CAL) Material.

Printed materials usually consist of textbooks and paper handouts. Students often comment that they find handouts very useful. Many students, particularly those who are struggling with mathematics, do not use textbooks as they can become overwhelmed by the amount of content. Students starting to use the support find short handouts, which are focused and to the point, more beneficial. They can be used to help students deal with important ideas in small stages. Some centres only hold reference copies of the handouts, others print copies which students can take. It depends on the finances available. We have listed some of the more popular handouts below along with the websites where they can be accessed.

- Engineering Maths First Aid Kit (www.mathcentre.ac.uk/search/?q=engineering)[1]
- Algebra Refresher (www.mathcentre.ac.uk/resources/uploaded/final1001-ltsn-ukmlsced.pdf)
- HELM resources (http://helm.lboro.ac.uk/)[2]
- Head Start Maths (www.sigma-cetl.ac.uk/indexphp?section=108)
- Mathematics Study Skills (http://maths-study-skills.open.ac.uk/p1/intro.html)

[1] Having followed this link, it is necessary to scroll down the page to find a link to download a zip file containing all the Engineering Maths First Aid Kit resources.
[2] Individual students cannot access HELM resources directly. Institutions can become registered users and then make resources available to their students.

The website **math**centre (www.mathcentre.ac.uk) is a very good source of extra material. The site contains a huge array of free resources thereby providing the vast majority of the material you will need. There are a wide range of topics and resources available to support students from GCSE-level to higher education, including self study guides, test yourself diagnostic tests/exercises, video tutorials, iPod and 3G mobile phone downloads. These high quality resources have been developed over many years and are undoubtedly of a very high standard. In addition to the main resource bank, **math**centre also hosts a community project where mathematics support providers have uploaded their own materials. Although these resources have not had the rigorous quality checks of the main materials, they are still very useful and may save you the large amounts of time needed to develop your own resources. The popularity of the website is clear from the average of 20,000 hits it gets per month.

In addition, many institutions have developed their own resources, so it is worthwhile to check out individual MSC websites for extra materials. A comprehensive list of institutions providing MSC help is available in Perkin et al. (2012). You can also use the **sigma** Network mailing list to check for additional resources.

It is important to stress that we strongly advise against starting the production of your own resources on a large scale without a thorough investigation of existing materials. There is a wealth of material that is already freely available and your time would be better spent actually working with students rather than producing another version of existing material. You should only produce resources for niche topics where no materials currently exist and then make them available through the **math**centre community project.

Students who do not struggle, or indeed students who become more confident in their ability, can find textbooks more useful than students who are initially struggling. The choice of textbooks depends on the institution, but it is useful to have at least one copy of the main module textbooks used by attendees. They are a good source of reference for both staff and students – it helps if staff show students how to locate specific materials within a given book. Gradually, if you have space, you can begin to establish a small library of useful textbooks at relatively low cost. Most academic staff receive free sample books (that they do not want) from publishers, and are often happy to donate these to the MSC.

Many centres also have computers available which can be used for a wide range of CAL material. Again, determining what resources should be available depends on a number of factors, mainly the type of support you are providing to students, whether there is funding available to purchase computers and resources and if your staff are trained to use them.

Many MSCs use their computers to assist students in finding and using relevant material from websites such as www.mathcentre.ac.uk, www.mathtutor.ac.uk, www.statstutor.ac.uk, www.patrickjmt.com, www.khanacademy.org. We discuss on page 20, how MSCs which are specifically designed to help with statistics can often also use computers.

A word of caution

As we stated earlier, the most important resource is staff. You can provide all the extra (non-staff) resources that you want, but it is very important that students are aware that these resources are supplement to but not a replacement for their learning experience. At some stage students need to take responsibility for their own learning. Students often do not see that the main process in understanding mathematics is to try it, get it wrong, and then seek help. Getting students to come to you with mistakes and attempts is an important step, once they get to this stage (which is a challenge we addressed on page 15), then staff advice, or the relevant handout or video etc. will be of much more benefit to them. Yet again, this highlights that expert staff are the number one resource that any support centre can have.

Key Points

- There is a wide range of resources that you can use to assist your provision of mathematics support; these include handouts, online resources, students and staff.
- Suitable staff are your most important resource; they provide the one-to-one interaction that students value over all other forms of support.
- There is a vast number of existing resources freely available online, they will cover almost all material that you need; www.mathcentre.ac.uk should be your first port of call.

Students as a Resource

The needs of students are central to why mathematics support is established and developed. In light of this, in many institutions students themselves are increasingly playing a key role in shaping how support initiatives operate and, in some cases, actually delivering some of the support activities.

Many institutions are now using their undergraduate students to help publicise the support services available to their peers. The students, often termed student ambassadors, are developing imaginative ideas for the promotion of support amongst their peers; for example, they are designing their own posters (see the examples in this section) and recording their own videos for the centres. Examples of these videos are available from http://mlsc.lboro.ac.uk/services.php and www.youtube.com/watch?v=C6OC_IJwP3o . Students are also contributing to drop-in centre decoration, and student ambassadors are visiting classes to promote the various support initiatives – they share their experiences and help to break down the barriers for other students. Further information is also available in the **sigma** document Celebrating Success in Mathematics and Statistics Support which is available at http://sigma-network.ac.uk

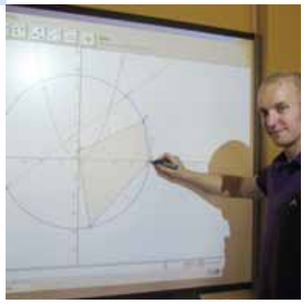
Some institutions are also using undergraduates to help with the provision of their mathematics support, for example as proctors to provide triage support under the guidance of tutors or as part of peer-mentoring and/or peer-tutoring schemes. Other schemes include students contributing to module course design, for example the Symbol project at Loughborough University (http://sym.lboro.ac.uk/index.html). A variety of student ambassador schemes have been established nationwide, and some of these are reported on in the 2011 CETL-MSOR Conference Proceedings which are available from www.mathstore.ac.uk/?q=node/2049. There is also the Good Practice Guide for Undergraduate Peer Support which is available from www.mathstore.ac.uk/headocs/Kane_Book.pdf

Students can play a key role in the provision and promotion of mathematics support, for example, student evaluations report that the friendly, supportive, non-judgmental ethos, the provision of opportunities for students to learn from both their peers and the centre tutors, has made a huge difference to their learning.

Where additional funding is available, several MSCs run student intern schemes during the summer vacation. In these schemes, interns (who are usually students at the end of their second year) work with mathematics support staff on specific projects which might relate to development of resources or research into factors affecting the operation of the mathematics support provision. These can be very valuable for the MSC as they provide not only 'an extra pair of hands' to do tasks that otherwise might never be completed, the students also provide the 'user perspective' in a way that staff never can. Internships are hugely beneficial for the students too as they give them the opportunity to develop their communication and research skills as well as their own understanding of specific areas of mathematics when they produce resources.

Key Points

- Students can play an important role in mathematics support through a range of activities including promotion of the support available and contributing to peer-support.
- Having students design your publicity materials can help to 'reach' the harder-to-reach (i.e. less engaged) parts of the student body.
- For suitable ideas, you should check out the range of projects that already successfully use students as a resource.



Statistics Support

Many of the issues we have dealt with already using the general term mathematics support are also pertinent to statistics support but in this section some additional points are emphasized.

Students from an increasingly wide range of disciplines include a statistical element in their project work. Here, statistics is taken as the collection, analysis, interpretation and dissemination of data. For many it is their only encounter with statistics, an encounter that does not always go smoothly.

Statistics is sometimes seen as a sub-discipline of mathematics. However, that does not mean that those capable of teaching or understanding mathematics are necessarily those capable of teaching or understanding statistics, and vice versa. Thus it may be necessary for an MSC to source suitable staff to provide statistics support, in addition to those who are providing mathematics support.

Particularly when only a small amount of statistics is covered, it may be embedded within the lectures for the main discipline, and is sometimes taught by those who are not comfortable with the subject and this can generate problems later on. For example, there are still those that insist on describing significance at the 95% level (rather than 5%).

In health sciences, social sciences and business (amongst others) questionnaires are quite popular. Advice is often necessary to ensure that the appropriate questions are asked (and data gathered), that sampling is appropriate and that sample size is adequate. Despite constant reminders, the message that projects should be designed and piloted, that hypotheses be generated, and that analysis be considered during planning is frequently ignored and support staff often have the challenge of helping to resuscitate some projects.

In many situations, there is more than one way to analyse and present a set of data. The support statistician needs to be aware of what the students' limits and skills are. For example, it may be far better to encourage them to generate graphs in Excel if they are already familiar with that package, or to do a nonparametric test on a subset of the data rather than taking the purist stance that they firstly learn 'R' programming and some advanced theory. The support statistician needs to be able to communicate at a variety of levels; undoubtedly they will have to deal with a spectrum of abilities, courses and faculties. In mathematics there is frequently an exact answer. By contrast, uncertainty is inherent in results from statistical analysis and this often causes comprehension issues.

It is good practice to have materials prepared for common problems in the packages available to the students to avoid having to cover the same ground over-and-over again. For example: how to do a chi-square test of association in Excel, or a Mann Whitney test in SPSS. An increasing range of resources is available at www.statstutor.ac.uk. Worked examples from available data sets are most useful to students so that they can work through the solution. However, it is important to not always show a student how to do a particular test on a computer. It is more beneficial for them if you actually set them up on the computer so that they perform the keystrokes, and then you can advise. It takes longer, but they learn and remember better this way.

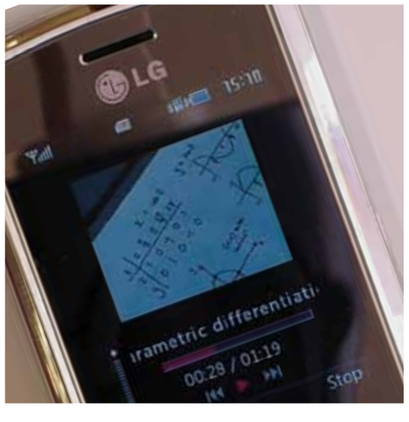
Drop-in sessions can work well for problems that can be dealt within a relatively short period of time, no more than 15 minutes. Any longer than this and it is recommended that a 30 minute or 1 hour appointment is booked to deal with the matter. It should be noted that requests for support increase dramatically as key project hand-in deadlines approach.

While the support statistician wants to help all students that come seeking assistance, a measure of realism is needed. Some students may have data unsuitable for analysis because sample sizes are too small, or the collected data are inappropriate to answer the posed research hypotheses. Occasionally the student will want to carry out some obscure analysis unfamiliar to the support statistician. In the latter circumstance, and given that time is a finite commodity, it may be necessary for the support statistician to clearly, and firmly, state that they cannot help. The student should be referred back to their supervisor unless the support statistician knows an alternative source of help. This may sound harsh, but the support centre is not a primary source for, or alternative to, teaching. It is there to help students who are having difficulty putting into practice what they should have experienced in the classroom.

Therefore, it is sensible if the support centre statistician can liaise with as many student tutors as possible to ensure that it is widely known what statistical support is available and what the limits to that support are. Emphasizing that students should seek advice as early in their project as possible is preferable to spoilt projects or queues building up in the days preceding key deadlines. This should be clearly communicated to the person who runs the MSC, and thus be included as part of the MSC advertising and publicity campaign (page 15).

Key Points

- Not all mathematics support tutors can support questions of a statistical nature; it may be necessary to employ an expert tutor for statistics queries.
- Students can come with a wide range of statistical queries, so it is useful to have appropriate resources ready for the most commonly asked questions in order to avoid repetition.
- Sometimes it is appropriate that certain questions from students should be directed back to the student's supervisor. The support provided is not a replacement for class teaching or proper project supervision.



Supporting Neurodiversity

Within the framework of widening participation, there are increasing numbers of neurodiverse students entering Higher Education (HE). The term neurodiversity is used here to refer to the range of specific learning differences (SpLD) such as dyslexia, dyspraxia, dyscalculia, AD(H)D and Aspergers' Syndrome.

These students enhance the learning environment with their many strengths and abilities making diversity a vibrant concept but, at the same time, posing challenges to our pedagogical thinking. The strengths, according to Cooper (2009, p66), include approaching academic tasks from unusual perspectives, making unusual connections and being creative and producing new ideas easily.

In 2010 The Equality Act, building on The Special Educational Needs and Disability Act (SENDA, 2001), came into force in the UK. Institutions have a legal obligation to make 'reasonable adjustments' for disabled students to allow and facilitate access to their goods and services and to ensure disabled students are not unfairly disadvantaged. There is also a requirement to introduce 'anticipatory measures'. This might include provision of materials in Braille or alternative assessments where needed. The legislation seeks to remove barriers and promote best practice for the inclusion and equality of opportunity for all.

Neurodiverse students will benefit from systematic support that places their individual needs at the heart of the process, understanding that there are differences in how they learn and adapting the teaching to each individual's needs. In practice, the learning support should provide a quiet space with a rich, multi-sensory environment in which the student and tutor are able to explore the issues through meaningful, student-centred dialogue that reaches to the core of this metacognition that will enable the student to move towards independent learning.

The Particular Needs of the Neurodiverse Students

This section explores the needs of a range of neurodiversities, outlining the issues that students may experience and providing examples of how one-to-one mathematics support can help.

Dyslexia implies a student may have difficulty with the development of reading, writing and language related skills, phonological processing, an inefficient working memory and slower processing speed. These are important elements in mathematics at any level and will therefore lead to consequent mathematical difficulties. Further, in mathematics there is frequently a significant emphasis on remembering facts and procedures, rote learning and recall, which serve only to disadvantage the dyslexic student, who is unable, through this means, to demonstrate their mathematical understanding. However, dyslexics are frequently able to visualise situations, approaching a problem from an alternative viewpoint, and thinking 'outside the box'.

Mathematics support tutors may assist dyslexic students by focusing on recognising and understanding the key aspects within given mathematics task sheets, examination questions and lecture notes. Such material comprises both text and non-text but as the symbolic material often will not pose difficulties it can be used effectively, together with some key word recognition to yield greater clarity of meaning. Trott (2012, p25) states: *"These key words enable a clearer focus in order to prioritise responses. It is important, therefore, to make all notes and handouts available for students to download and format as they choose."*

Frequently, for the dyslexic student, the issues involve reading the accompanying text and reading speed, so that there is a need to dissect or simplify the text into more manageable form, using bullet points, for example. They may also, when reading, replace a word with a similar word but that changes the meaning: e.g. Eigenvalue/Eigenvector, Diagram/Diameter or Integer/Integral. Furthermore, working memory is a key aspect of dyslexia and learning support will enable the student to develop strategies to aid working memory. This may involve a range of multi-sensory ideas and tools: post-its, colours, music and posters such as a pair of posters depicting fire and a sea with the heat and wave equations attached respectively.

Dyspraxia impinges upon hand/eye co-ordination and fine motor skills. Problems with pen control can lead to messy cluttered and mis-aligned work. Dyspraxia can also affect organisational skills that, in turn, will have implications for meeting deadlines as well as sequencing work. However, dyspraxic students are likely to be creative, determined, motivated and good problem solvers.

Dyspraxic students often produce notes that are difficult to follow, lacking a sequential order. One-to-one support focusing on organising and presenting mathematical written work so solutions are more cohesive can be helpful. It can also be useful to focus on reducing copying errors that frequently occur from line to line or page to page, e.g. ≤ to <. Support may also focus on strategies for aiding memory, particularly in relation to keeping track in multi-step tasks, enabling all aspects of a problem to be kept in view. Different colours for each function, variable or process may be used (differentiating in blue and integrating in green) as well as keeping track of variable notation particularly Greek characters.

Dyscalculia has implications for the fundamental understanding of basic number and mathematical concepts and relationships. Trott (2009, p126) elaborates on this, noting that mathematical ability is significantly less than expectation and there is an affect on both academic and daily life. Dyscalculic students weaknesses may include *"conceptual understanding of number and operations as well as the ability to tell the time and understand graphical information."* (Trott, 2010, p71). They are often unsure of basic operations and frequently use inappropriate strategies. There is often confusion between basic ideas such as rows and columns. Visual reminders such as pictures of horizontal rowing boats and vertical Greek columns can be useful. When presented with large amounts of information, it can be helpful to cover up sections of the information to allow the student to focus on the relevant information. Working through the concepts in a slow, methodical way with repeated recapping can produce good progress.

AD(H)D is characterized by inattentiveness, hyperactivity and impulsivity. The student is likely to shift between multiple incomplete activities, lack organisation and be easily distracted. They may appear restless and, in the group situation, interrupt others without waiting for their turn to speak. However, they have the ability to see the 'big picture' and are creative and intuitive with high energy levels. They are often natural risk takers, leading to insightful discoveries.

In mathematics learning support, short-term goals, with an emphasis placed on keeping on-task, without interruption should be set. Students will have a short attention span and this should be recognised by including short breaks after a fixed period, say 20 minutes. A reference point should be set before the break to enable the student to return to where they left off. The time interval before breaking can be gradually increased until the student can complete a whole problem, and, eventually, a full one-hour session.

Aspergers' Syndrome is likely to impact on social interactions and communication skills. Students are less likely to understand others feelings or develop peer relationships, not understanding the usually accepted rules of social behaviour, taking language in a literal sense and speaking at length on a topic of special interest. There may be a lack of flexibility, a need for routine and, frequently a hypersensitivity to light/noise. However, a student with Aspergers' Syndrome will show great attention to detail, hitting all deadlines with a focused determination and they are likely to be highly independent learners, avoiding group situations. Students with Aspergers' Syndrome may need a quiet environment in which to work.

They may also need support to be focused particularly on transferring theoretical subject knowledge into applications.

Some neurodiverse students experience **visual stress**. Material on the page appears to move around, blur or 'fizz'. This can make it difficult to accurately copy information, line up digits, work with subscripts/superscripts, cope with some fraction notation, accurately read statistical tables and spreadsheets or use graph paper. Material produced in the more accessible sans serif fonts (Arial or Verdana) can really help, as can well-spaced documents with clear headings. A coloured background, rather than black type on white background, can reduce the glare that many neurodiverse students encounter through visual stress.

How such support can be delivered

Neurodiverse students may have a Disabled Students Allowance (DSA), which specifies that the student be entitled to a set number of hours of one-to-one mathematics learning support. The objective here is to address the neurodiverse needs of the individual student. Discussion with the student, particularly at the initial meeting, will help to agree the targets, both neurodiverse and mathematical. This will, of course, be individual, but could be, for example, in the case of a dyslexic psychology student, include reading strategies to identify and understand key words and symbols used in questions and to understand how to read and interpret publications that intersperse text with notation, writing strategies for producing appropriate statistical reports and working memory strategies to explore a variety of memory aids for different tasks and equate the wording of the task to existing knowledge. Near examinations the targets could extend to revision techniques and writing appropriate, focussed answers within a time limit. This work would be channelled through statistics material involving lecture notes as well SPSS instructions and printouts.

At Loughborough University, one-to-one mathematics support for students with additional needs has been in place for several years. The main student drop-in service runs in tandem with the additional needs support. Neurodiverse students are able to access both centres. However, the nature of the support they can expect from the centres is different. In the main drop-in they will receive mathematics help that supports their course of study, addressing a specific mathematics problem. In the one-to-one situation of additional needs support, they can expect to be the main driver of the sessions, exploring the neurodiverse issues in the context of their mathematics. Tutors have a mathematics background and have additional training in neurodiveristy, with regular CPD opportunities. The Postgraduate Certificate in Mathematics Support and Dyslexia/Dyscalculia in FE/HE (http://pgcert.lboro.ac.uk) was set up in response to the demand for specialist training in supporting dyslexic and dyscalculic students with the mathematical and statistical elements of their courses. The course has British Dyslexia Association accreditation.

Within the university, students are referred to the one-to-one mathematics support service through a range of avenues. These include referral from colleagues in the university's disability service, counseling and mental well-being services and the Study Support Service. Overall, these services have a joined-up approach, with students moving between the services as appropriate. Students are also referred from the main drop-in centre, when a member of staff becomes aware of the difficulties a student is experiencing. It is therefore important for staff in the main centre to be aware of the issues that might be apparent in a student, this would include taking longer to process information, difficulty reading instructions or information, messy or disorganized work, missing or incomplete notes or inattentiveness. Simple checklists for centres are available from The Dyscalculia and Dyslexia Interest Group (http://ddig.lboro.ac.uk/tutors.html).

Evaluation

The provision of mathematics support is a developing area – there is good practice to learn from but no cast-iron approach that is guaranteed to bring success. As in virtually all walks of life, evaluation and reflection can suggest ways in which things can be improved.

Mathematics support exists primarily for the benefit of students and so providers should always be open to learning how to make their service 'better' so that either more students benefit or that students benefit more. And since mathematics support consumes resources (even if the only resource is your time), the institution (most likely in the form of the PVC for Teaching and Learning) will want to know that these resources are being used wisely and producing the desired outcomes. For your own personal and professional satisfaction, as a provider of mathematics support you should also be interested in the outcomes of evaluation.

A recommended first port of call for essential information on evaluation is the webpage maintained on the **math**centre website by Professor Tony Croft which contains a range of material on measuring the effectiveness of support centres http://mathcentre.ac.uk/topics/measuring-effectivess/measuring-the-effectiveness-of-support-centres/

If you are providing mathematics support, then you should try to evaluate the effectiveness of the support offered so you can determine best practice. From the support centre's perspective, there is a need to ensure that valuable support is provided and there is a constant need to maintain and enhance the quality of the provision in the ever-changing environment. Not only will it help you with the day-to-day running of your facility, it can also play a key role in your applications for funding, new resources, proper facilities etc. The outcomes of evaluation can also form an integral part of your advertising and publicity to increase student engagement. Proper evaluation, though often time consuming, can allow your support to grow organically to fit the needs of the institution in which it is based. When evaluating, it is important to strike a balance between qualitative and quantitative data.

However, a rigorous evaluation of the effectiveness of a mathematics support initiative is a difficult and time consuming operation. The first essential piece of advice is that you maintain accurate data on every activity that you run. Most centres record basic information on the individuals who access their services. The depth and breadth of this information varies from institution to institution. Centres that request personal student information often also distribute a registration form for the first visit where reasons behind these requests are explained, confidentiality is assured and ethical issues are clarified. Students are sometimes asked to sign these forms if they agree to allow this information to be used anonymously for evaluation purposes.

Centres which are not incorporated within or closely tied to a particular school often maintain a record of anonymous information only, e.g. MSCs often ask many of the following questions: the school/faculty that the students are from, how they heard about the support initiative, the reasons why are they coming, the specific material they need help on, whether this is their first visit and requests for feedback on the session. This information is useful, and in particular it can help indicate what type of resources should be available. If students from a particular school are attending very frequently, then it may be possible to seek some additional funding from their school or department. Feedback for each session allows the person running the centre to follow up quickly on any issues that arise.

Some centres also record the time of entry and exit, as this allows them to see the pattern of student engagement over a period of time, and then they can assign their staff accordingly. Centres often ask for the students' email address so they can email them with updates on centre news, other centres also query students' backgrounds, e.g. Mature, Access or Disability. Again, this allows the centre to cater their resources appropriately, and possibly ask for extra funding from a particular office if many of their students are attending.

Many other centres, typically those which are closely connected to a particular school or faculty, also record the student name and student number for each visit.

This allows them to build up a very accurate picture of class engagement levels. Some of these centres have access to student records such as module grades, attendance at tutorials and coursework marks. It can be possible to compare the grades of attendees with non-attendees and break this down according to their mathematical backgrounds. Such comparisons usually show that the regular users perform significantly better on average than the non-users. Centres can also look at retention and progression rates within particular groups.

However, in general it is very difficult to establish conclusively from this quantitative data that the MSC has made the difference, or that it is the key reason behind the retention of any particular student. It can be argued that regular users are better motivated students who would have found another source of help had the support centre not existed.

The most common method of evaluating the effectiveness of the centre is through student questionnaires which are distributed in a variety of ways. Some are distributed to students visiting the centre, and although this can give useful feedback, the sample of the whole student body is biased in favour to those who already value the centre. Other institutions place questions about the usefulness of the centre on their module questionnaires. These questionnaires reach a wider audience than those who come into the centre and so are probably more useful. Several institutions, with permission from individual staff or schools, distribute MSC questionnaires in the main service mathematics lectures. These generally give the best balanced view of the support available from attendees and non-attendees.

Before you begin to develop your own evaluation or questionnaire, you should consult the **sigma** guide 'Gathering student feedback on mathematics and statistics support provision: a guide for those running mathematics support centres'. This recent (2012) guide contains a thorough description of the wide range of student evaluation that you should consider.

The guide contains advice from a number of individuals who offered suggestions on evaluations and who provided samples of the measuring instruments they use in their own institutions. It discusses many of the following issues in detail: Why should you gather feedback? How do you gather feedback? Who should you ask? What information should be gathered? When and where do you gather it? It goes on to discuss issues of retention, ethical considerations and it provides a bank of sample questions.

The purpose of student evaluation is to try and ensure that students are being supported adequately. This is not easy to measure, and typically the best result that you can hope for from an evaluation is a combination of qualitative (including appropriate quotes) and quantitative data which shows that students are happy with the support provided, that they are finding it easier to deal with mathematics, they are more confident in their abilities and they are no longer considering dropping out of university (if they were considering this in the first place) because of difficulties with mathematics.

When presenting a complete report on the MSC to your institution, it is important to present a fair balance of the data from a variety of the sources previously mentioned. From the institution's perspective having satisfied students is important, as is, of course, good academic performance and, ultimately, graduate employment. These affect the running of the institution on a day-to-day basis and its external reputation, particularly through League Tables and external awards.

However, ultimately the number one purpose of a support initiative (at least when they are first established) is to ensure that fewer students fail because of difficulties with mathematics. If you have evidence of this, then you can argue to the institution that the support provided is cost effective (along with all the other positive outcomes of the evaluation). The cost of a student dropping out is not an easy thing to measure and the **sigma** guide goes into the issues involved in further detail. However, if student retention is higher because of the support available, then it is possible (although difficult) for the institution to put a figure on how much money they have saved.

Even if you can only demonstrate that you have 'saved' one or two students, then this usually more than pays the cost of establishing the support in the first place.

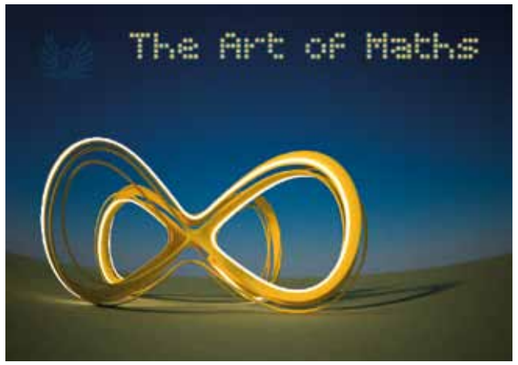
The evaluation of MSCs is usually very positive and their impact is often cited during external reviews of your institution, such as QAA institutional audit and professional body accreditation visits. For example, the report of the 2012 QAA Institutional Audit of the University of York states that the review team found "the successful establishment of the Maths Skills Centre to support students across a wide range of disciplines" to be a feature of good practice. This can give a useful external input to reflecting on the effectiveness of the support provided. You should also make a note of every time your institution has quoted your support as evidence of their commitment to student support. This is useful when you are seeking extra funds.

These evaluations are sometimes used by MSCs in their advertising campaigns to attract new students. Some institutions have witnessed a significant increase in attendance amongst class groups who were shown the increase in confidence, the reduction in likelihood of dropping out, and the improvement in grades that they could expect if they engaged appropriately with the support available.

Finally, two further documents that will be extremely useful to you for issues concerning evaluation are: Matthews, Croft, Lawson and Waller (2012) which examines published studies that relate to the evaluation of mathematics support centres, and MacGillivray and Croft's 2011 paper *Understanding evaluation of learning support in mathematics and statistics*.

Key Points

- Details of every activity that you undertake should be recorded and analysed.
- You should read the existing expert opinion on the evaluation of mathematics support.
- Thorough evaluation of all aspects of your support provision is essential to determining best practice: it allows you to review your provision; it ensures that students are getting appropriate support; and it contributes to your funding requests.



Conclusion

The purpose of this booklet is to provide guidelines on how to set up and maintain an effective MSC. It relies heavily on several expert reports and papers that deal with the wide range of issues that you encounter during the process. These were all listed in the introduction and are essential reading. We looked at key issues such as the ethos and location of the support, staffing and training, the range of resources and types of provision available, student engagement and evaluation.

Several recent reports have highlighted that the issues associated with the well documented 'mathematics problem' are still prevalent and are highly unlikely to disappear in the foreseeable future. One response from HEIs has been the remarkable growth in mathematics support in the last twenty years, which has become widely established both nationally in the UK (over 85% of HEIs) and internationally. In fact, mathematics support is becoming deeply embedded in the infra-structure of student support in higher education. Several institutions include reference to mathematics support in their OFFA Access Agreements.

Mathematics support covers a broad spectrum of initiatives, which vary from institution to institution depending on many factors including funding, variation in degree structures, location, the range of student needs and the benevolence of the individual institution. We discussed the range of resources that are made available to students and identified staff as the most influential. Feedback from students consistently shows how they value interactions with tutors.

Why is mathematics support so popular with students and institutions? Staff involved can see the impact it has on students and it is constantly reviewed, evaluated and developed to address the needs of the students. However, it is not easy to demonstrate a clear cause and effect in the outcomes of mathematics support. It is also important to stress that while mathematics support is a very effective part of the solution to the 'mathematics problem', it will not solve all problems for all students.

In general, accurate data collection and regular evaluation shows that students who regularly access support provided have more confidence in their ability and have a more positive attitude towards mathematics. There is also evidence which suggests that mathematics support also contributes to improved retention and progression rates, and though this is much harder to prove, institutions lose money for each student that drops out, so if support saves only a few such students then it will pay for itself.

Working in mathematics support can be very stressful and frustrating, particularly when there are students you know would benefit from the help who are not accessing it. However, the provision of mathematics support is also very rewarding. Hopefully this guide shows that you have the opportunity to react and innovate to address the range of students' needs and you can see the positive impact that the friendly, welcoming and non-judgemental atmosphere of an MSC has on students' attitudes towards mathematics.

It is an environment where students who previously hated and feared mathematics now frequently report that they enjoy working on material on their own or with their peers. This is an extremely positive step in trying to address the 'mathematics problem'.

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