

**Training in Teaching for New Staff in
UK University Mathematics
Departments**

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Chapter 1

What this book is about

The training of new lecturers in U.K. Higher Education is a recent innovation. Since the outset it has been largely the preserve of generic staff developers, with the voices of practising academics rarely heard, even though they might be expected to have something to say about the way that the teaching of new staff in their disciplines should be shaped by their training. In this book we try to make good some of this deficit in respect of mathematics. We report both on the experience of mathematicians undergoing generic training, and on our own experience running subject-specific training for new mathematics lecturers. To our knowledge, we are the first to do so, at least in a UK mathematics department.

One of our aims is to promote debate on the balance between generic and discipline-based provision in staff training, and we are fairly critical of generic provision; we have encountered widespread dissatisfaction with it among mathematicians, which deserves to be addressed. However our message is not just one of criticism of generic training; we believe that part of the responsibility for the present unsatisfactory situation lies in the failure of mathematicians to set the agenda for the training delivered to their new colleagues.

1.1 The training of new lecturers

We begin with a quote.

[There are groups of scholars all over the country] who would not make a decision about the shape of a leaf or the derivation of a

word without painstakingly assembling the evidence [and yet are quite content to make decisions about] admissions policy, size of universities, staff/student ratios, content of courses and similar issues, based on dubious assumptions, scrappy data and mere hunch.¹

Surely we can do better than that!

However, we do not believe that this will be achieved through an academic training in an all-purpose theory of teaching. Instead, a significant part of the training of new staff in university mathematics departments should be incorporated into the normal run of departmental activities, in the form of collegial apprenticeship. The book argues this view, and offers guidance to mathematics departments wishing to act on it. It is based in part on experience running such a scheme in the Mathematics and Statistics Departments at the University of Warwick, where it has been successful both in training new staff, and as a means of focussing departmental interest in teaching.

We advocate a programme of training incorporating

1. Collegial apprenticeship and mentoring within the lecturer's own department
2. Subject-specific training courses taught in national or regional centres, such as the Induction Course for Lecturers new to Teaching Mathematics in UK Higher Education offered by the MSOR² Subject Centre (see Subsection 2.8.3 below), supported and informed by input from the Mathematics Education community.
3. Institutional staff development courses, taken with lecturers in other disciplines, covering topics on which there is common ground.

We believe that the first of these should form the core of the training, while the Institutional Staff Development Centre (ISD) should provide the necessary unifying framework, training in mentoring, advice, accreditation and administration, together with the courses of the third kind.

¹Lewis Elton, [11].

²Mathematics, Statistics and Operations Research

1.2 About the authors

The authors of this book are mathematicians working in UK universities. Bill Cox has been involved in both generic and discipline-based training for new lecturers since 1990, both in his own department at Aston University and in the MSOR Subject Centre, where he is a regular contributor to the annual Induction Session mentioned earlier. David Mond is Professor of Mathematics at Warwick, and, with Trevor Hawkes, set up the first mathematics departmentally-based teaching certificate in the UK, at Warwick in 2005.

1.3 How to use this book

We have written with three audiences in mind. The first consists of Heads of Department, who we hope to convince to implement the departmentally-based training that we advocate, in place of the largely generic and non-subject-specific training delivered by central Institutional Staff Development centres in most universities. The second group consists of the members of department who, if we succeed, are then charged by the Head of Department with the task of setting up and running such a programme. For the latter we have provided more detail than the former may want to read; in particular, some of the detail on the structure of a departmentally-based programme in Chapters 4-6 can surely be skipped. On the other hand, the Head of Department will also need some convincing that a departmentally based programme is feasible and not excessively costly of staff resources. We believe that Sections 3.2, 4.1, 5.1 and 5.2 can quite quickly make clear that this is so – and moreover that the benefits to the department’s teaching can spread well beyond the new staff.

The third consists of staff development professionals.

To all three groups we offer a challenge: most of the training currently provided does not achieve its aims, and it is incumbent on mathematicians and staff development professionals to devise something better.

The book begins with a polemic, in Chapter 2, in which we hope to convince the reader that there are clear questions concerning the appropriate balance between generic and discipline-based contributions to staff training. We believe that a debate is necessary, and hope that the questions we raise here will contribute to it.

1.4 New challenges in the teaching of mathematics in Higher Education

What has led to the demands for the professionalisation of university teaching? It is useful to have a summary of what is driving this change. Most departments will be affected of some of the following:

1. With widening participation we now take a much wider range of students. This demands a wider range of teaching skills.
2. The UK is finding it increasingly difficult to grow its own academic staff in the sciences, and is simultaneously benefiting from the increased globalisation of the academic jobs market. This presents us with several challenges. The arrival of foreign-trained academics gives us the opportunity to gain from an influx of new ideas and approaches, but also obliges us to think through those aspects of our academic and educational structures which we wish to preserve. To increase the supply of UK mathematics graduates doing PhDs, we need better and more inspirational teaching - see e.g. [5],[13],[29] for evidence of how serious the current shortage is. And to integrate new arrivals into UK Higher Education we need to make available, through our training programmes, a more explicit picture of its structures, processes and values.
3. We are continually beset with claims of different and better teaching methods (e-learning, problem-based learning, etc). We need to be informed and knowledgeable of such things and be in a position to assess them critically and expertly.
4. Increasing student fees are leading to demands for better teaching and support for learners.³
5. Global economic, social and political changes have led to cutbacks in spending on public services and to increased demands for accountability and measurement of performance in the public sector. These are frequently coupled with a scepticism of the ability of public sector employees to do their jobs properly.

³A possible concomitant of this is the fact that student complaints to the Office of the Independent Adjudicator are increasing annually by about 20% (Times Higher Education Supplement, 19-5-2009). See also “LSE set to refocus on teaching”, *ibid*, 7-12-2007.

6. Global competition in the ‘knowledge economy’ is increasingly fierce. Our graduates, at whatever level, need to be world class, so our teaching needs to be of top quality. A minimalist approach to HE teaching “because we take the best students” never was a wise policy, and is untenable in the current climate.

1.5 Glossary

APL	Accreditation of Prior Learning - reduction in obligatory training on account of previous training or experience
CPD	Continuing professional development - the field of which the training of new staff is a part
HE	Higher Education
HEA	Higher Education Academy: government-funded but nominally independent body overseeing training of academics
ILT	Institute of Learning and Teaching: precursor of the HEA
ISD	Institutional Staff Development Centre: unit in university or college providing training to all academic departments
LMS	London Mathematical Society
MSOR	Mathematics Statistics and Operations Research; also MSOR Subject Centre: dependency of the HEA, located in Birmingham University and staffed by mathematicians specialising in the teaching and learning of mathematics in HE
Department	Academic department, sometimes known as School
Course	Degree course
Module	Unit of instruction in a degree course, e.g. Analysis I
PGCHE	Postgraduate Certificate in Higher Education
PGCert	Postgraduate Certificate
PSF	Professional Standards Framework published by the HEA - see Section 2.1.
SEDA	Staff and Educational Development Association
TC	Teaching Certificate

Chapter 2

Training new university lecturers

2.1 National policy - The Professional Standards Framework

In recent years the training of university teachers has risen up the Higher Education agenda, prompted by the requirement in the 2003 White Paper *The Future of Higher Education* ([9]) that all new university staff engaged in teaching be trained from 2006. We quote:

At present, there are no nationally recognised professional standards for teachers in higher education; and many of those who teach have never received any training in how to do so. In order that teaching in higher education is treated seriously as a profession in its own right, and that teachers are given the skills they need, we expect that national professional standards will be agreed by 2004/05, through the proposed new teaching quality academy, described below. These standards, to be designed and agreed by the sector itself, would then describe competences required for all teaching staff. Training of new staff to meet the standards should be possible through a wide range of different programmes and courses, as best suited to the institution and individual concerned. Once the standards are in place and command confidence across the sector we will expect all new teaching staff to obtain a teaching qualification which meets the standards from 2006.¹

¹[9], 4.14

The professional standards called for in this document were published in February 2006 by the Higher Education Academy as the *UK Professional Standards Framework for teaching and supporting learning in higher education* ([14]), (henceforth *PSF*). It is reproduced below. The Teaching Quality Academy referred to in the quote has now come into existence as the Higher Education Academy.

THE STANDARDS

<i>Standards Descriptor</i>	<i>Examples of Staff Groups</i>
Demonstrates an understanding of the student learning experience through engagement with at least 2 of the six areas of activity, appropriate core knowledge and professional values; the ability to engage in practices related to those areas of activity; the ability to incorporate research, scholarship and/or professional practice into those activities	Postgraduate teaching assistants, staff new to higher education teaching with no qualifications or prior experience, staff whose professional role includes a small range of teaching and learning support activity
Demonstrates an understanding of the student learning experience through engagement with all areas of activity, appropriate core knowledge and professional values; the ability to engage in practices related to those areas of activity; the ability to engage in practices related to all areas of activity; the ability to incorporate research, scholarship and/or professional practice into those activities	Staff who have a substantive role in learning and teaching to enhance the student experience
Supports and promotes student learning in all areas of activity, core knowledge and professional values through mentoring and leading individuals and/or teams; incorporates research, scholarship and/or professional practice into those activities	Experienced staff who have an established track record in promoting and mentoring colleagues in learning and teaching to enhance the student learning experience

2.1. NATIONAL POLICY - THE PROFESSIONAL STANDARDS FRAMEWORK15

AREAS OF ACTIVITY, CORE KNOWLEDGE AND PROFESSIONAL VALUES WITHIN THE FRAMEWORK
<i>Areas of activity</i>
<ol style="list-style-type: none">1. Design and planning of learning activities and /or programmes of study2. Teaching and/or supporting learning3. Assessment and giving feedback to learners4. Developing effective environments and student support and guidance5. Integration of scholarship, research and professional activities with teaching and supporting learning6. Evaluation of practice and continuing professional development
<i>Core knowledge</i>
Knowledge and understanding of: <ol style="list-style-type: none">1. The subject material2. Appropriate methods for teaching and learning in the subject area and at the level of the academic programme3. How students learn, both generally and in the subject4. The use of appropriate learning technologies5. Methods for evaluating the effectiveness of teaching6. The implications of quality assurance and enhancement for professional practice
<i>Professional values</i>
<ol style="list-style-type: none">1. Respect for individual learners2. Commitment to incorporating the process and outcomes of relevant research scholarship, and/or professional practice3. Commitment to development of learning communities4. Commitment to encouraging participation in higher education, acknowledging diversity and promoting equality of opportunity5. Commitment to continuing professional development and evaluation of practice

Despite the importance attached to it by the White Paper, the PSF offers little explicit guidance to institutions wishing to train their staff. No doubt because it is designed to cover a vast range of provision across the whole HE sector, the PSF offers only very general aims. At best it provides a skeleton for provision, to be fleshed out according to the institution, the local context, including discipline, and the needs of the people to be trained. In practice the people responsible for training, such as the ISDs, sometimes in consultation with academic departments, would develop training programmes, such as the teaching certificates now awarded by many universities. Such programmes would be 'accredited' by the HEA, who would ensure that they meet the PSF. Since such programmes have to cover all subjects, they will inevitably have a generic core, independent of discipline. Discipline-based input would come from the academic departments. The HEA explicitly recognizes this in its descriptors and seventeen learning outcomes listed above, which clearly point to both generic and discipline-based input. Indeed, through its other policy documents it reiterates the importance of the discipline-based input and acts to facilitate this through its 24 Subject Centres.

Now the question inevitably arises - what is a reasonable balance between generic and discipline-based training? Specifically, if we are training a pure mathematics lecturer, what mix of generic and mathematics teacher training is appropriate? By training here we mean the formal, contact training involving workshops, lectures, discussion groups, etc, leaving aside the valuable apprenticeship that the lecturer receives in their day to day activities in the department, or the mentoring from experienced staff.

We can imagine two extremes - 100 percent generic training, with no mathematically-based input at all, taken in the company of lecturers from a range of other disciplines; or totally mathematically-based training, provided by expert mathematics teachers, in the exclusive company of other mathematics lecturers. Neither of these extremes seems ideal to us, even if they were practicable. Perhaps mathematics lecturers would need no persuading about the first extreme, but they should also not rush to the other. Contact with other subject areas can provide a valuable comparative perspective, and can lead to cross-fertilization between disciplines. Meeting people from other subjects should be a part of university life - and the opportunities for doing so are fewer and fewer as academics' time has increasingly to be accounted for.

So - where does the correct balance lie between these extremes? The answer depends on so many variables, and is so burdened with practical issues,

that one might be forgiven for despairing and settling for the status-quo. At the moment both the design and delivery of the training is almost entirely in the hands of generic providers, ostensibly on the grounds of efficiency. In most Teaching Certificates there is little or no specifically mathematical component in the formal training - it may come in the project, but rarely appears in the instruction. This is a real bone of contention amongst new mathematics lecturers (and probably history lecturers too), and their complaints are often justified. Even when there is the possibility of replacing generic modules by equivalent maths-based ones, as given by the MSOR Network for example, many ISDs will not allow any replacement. And surely the generic providers themselves must feel the strain of trying to train someone to teach in a subject they know nothing about and have never taught themselves. This issue of the balance between the two aspects must therefore be addressed, no matter what the difficulties. It has received very little attention. Only very recently has the issue been considered by generic providers, and it has not been considered rigorously at all by mathematicians, who often confine themselves to carping about the generic provision without making clear what is specific about maths teaching or what kind of training would be useful to mathematicians.

Someone has to make a start on this question. Below, we attempt to quantify the balance between generic and maths provision. For this we will use the only formal yardstick we have – the PSF. We consider each of the descriptors in the table above and give our assessment in each case of what might be an appropriate balance. We will try to be objective, but of course expect that others will have different views. The point is that so long as participants in such debate make some effort to justify their views then the accumulation of argument and evidence will be a worthwhile exercise from which we will all learn. In a rather tongue-in-cheek first stab at this, for each category in the PSF we suggested the percentage of input that should come from the two sides e.g. 80% generic, 20% maths. This was met with such derision by one (generic) reviewer that we nearly abandoned the idea. However, one mathematician reviewer immediately took up the challenge and argued with some of our percentages, reassuring us that he at least saw some meaning in them. It is dissent and debate we want. If someone, generic trainer or mathematician, takes exception to our assessment then we welcome their response. While the numbers we offer should not be taken too seriously, we are very serious about the process, and would like to promote rigorous debate about the issue. And although we focus on mathematics, it is clear

that a similar exercise could be carried out for any discipline.

2.2 The PSF's standard descriptors

For each of the descriptors we offer our views on what proportion of provision might be generic, what mathematically-based. Throughout it should be remembered that when we refer to mathematically-based training this would include that available from respected practitioners with experience and practical knowledge of teaching mathematics, and also the expertise available in the Mathematics Education community.

Design and planning of learning activities and /or programmes of study

This covers the mathematical content of our courses and the method of teaching it. Unarguably the former is one hundred percent in the maths domain. What about the latter? We can summarise the task as one of defining the objectives of the teaching (subject matter, generic, transferable, affective, psychomotor skills), designing instructional activities and student engagement with them that promote and achieve these objectives, and designing methods for determining the extent to which they have been achieved. Everything in the last sentence could apply to any subject. Therein lies its paucity of practical usefulness. Beneath its bland generality there is an iceberg of practical issues about the actual teaching. What are these activities, how do they relate to the subject matter, what sort of learning objectives are appropriate, can these be classified for maths in the same way as they can for history, would we use the same activities in history? What about the delivery mechanisms? We might use the same chalk and board as a language teacher, and we talk and walk as historians do, but is that all there is to it? In maths we not only explain and convey a body of subject matter, but we demonstrate modes of working. The filling of a board with mathematics, by the skilled teacher, can instil so much more than the information represented by the finished product. Rote learning, despised by historians as a learning activity, is absolutely critical to the well trained mathematician. And so we could go on - the generic tip of the iceberg, deliverable in a few short words merely signals a submerged mass of practical detailed teaching practice that is mainly maths-based with some useful generic air bubbles in the ice.

We think it is clear that the overwhelming bulk of the submerged iceberg in this area is maths-based.

Let's say Mathematics 90%, generic 10%.

Teaching and/or supporting learning

On the face of it it would appear that the argument here is similar to the previous discussion. This is not so clear however. Those components of teaching that rely on delivery via lectures depend a great deal (but by no means exclusively) on such performance skills as voice projection, holding an audience, generating an exciting environment, controlling the class and so on. There is a lot here that **is** generic, and indeed that can be most usefully learnt in company with lecturers from other disciplines. And the people skills needed in running an effective tutorial, again have large generic components. However, there is a big difference between a maths and a history tutorial. The latter might involve a lot of discussion, with plenty of room for opinion and not always clear cut answers. Certainly there is some room for such things in maths (for example debating the relative merits of an analytic and numerical solutions of equations), but these are the exception. Usually a maths tutorial is an intensive activity with individuals labouring away at a series of problems, calling on classmates or lecturer for help when needed. And when it comes to support for students in maths this might take the form of directing the student to do a lot of routine drill type exercises, essential in maths but anathema to a history student. A focused workshop, run by energetic and expert generic staff might be valuable, but would be unlikely to provide much help in the detail of running a maths tutorial. In brief, we might say that the generic provision addresses the **medium**, the maths the **message**. In this area of activity a substantial part of the input needs to be mathematical rather than generic.

Call it Maths 50%, generic 50%.

Assessment and giving feedback to learners

This too is like the first item. Training for assessment and feedback in maths has to be almost totally discipline-based. The generic tip of the iceberg is confined to generalities, discussion of validity, reliability and so on. The latter is important of course. It is not unusual for the maths lecturer who pours scorn on notions like validity to assess students' skill in proof by the invalid

method of testing the students on rote learned set-piece proofs rather than unseen proofs. But the generic provision does not provide a practical basis for developing the skills required in the actual assessment of mathematics. In fact, the presentation of this sort of training in a generic context can be positively harmful. For example, many generic teaching certificates require staff to demonstrate applications of innovative assessment methods that are entirely inappropriate in mathematics, or may over-emphasize such things as essays, which are rarely used in mathematics assessment.

Maths 90%, generic 10%.

Developing effective environments and student support and guidance

Similar to the second area. There are a lot of affective issues in this area of activity that are not only within the expertise of the good ISD, but benefit greatly from training in company with different disciplines. This area would contain a substantial proportion of generic training of the right kind, with the finishing touches added by mathematicians. There is a somewhat different slant to student support in mathematics as opposed to other subjects. In many arts based subjects one might justly refer a student with problems to some reading, a particular chapter in a book, for example. This is less usual in mathematics, or science-based subjects in general. Here the problems are usually more intricate and deep-seated and respond better to focused discussion with the student. Just referring them to a book will usually not help much; it is far better to work through an example with them.

Maths 50%, generic 50%.

Integration of scholarship, research and professional activities with teaching and supporting learning

This area requires high content knowledge and the ability to relate the curriculum being delivered to particular research areas in a way that the students will appreciate. This is highly discipline-based in both pedagogical and mathematical terms and it is difficult to see any room for a generic contribution, beyond a few general principles which in any case will be well known to mathematicians.

Maths 90%, generic 10%.

Evaluation of practice and continuing professional development

This is an area in which good generic provision can make a major contribution. Such things as making the best of student feedback, effective peer observation, staff development opportunities, etc are all within the remit of the typical ISD. Activities like this can often benefit from input from other disciplines, who can bring in other useful practices.

Maths 20%, generic 80%.

Core knowledge

Knowledge and understanding of the subject material

Clearly there is little room here for generic input, and performance in this area can only be judged within a mathematical context.

Maths 100%, generic 0%.

Knowledge and understanding of appropriate methods for teaching and learning in the subject area and at the level of the academic programme

Again this requires overwhelmingly mathematics-based input. What pedagogical input is required is amply provided for by the Mathematics Education community. Indeed, generic input can sometimes be inappropriate. For example many ISDs currently have a policy of promoting IT and other teaching innovations without a proper understanding of their efficacy in different disciplines, particularly mathematics. They often view 'chalk and talk' as old-fashioned and demand Powerpoint and online tutorials in its place. This is entirely inappropriate in mathematics, where 'chalk and talk' remains the medium of choice for very good reasons. When a mathematician works through material on the board they are not just conveying information. They are demonstrating modes of thought and engagement with the material. The finished product is almost incidental to the process, which is best done on a blackboard or white-board, is just about feasible on an overhead projector, and is almost impossible on Powerpoint.

Again, many ISDs regard the traditional time-limited unseen exam as out of date, and argue for innovative assessment methods. Their enthusiasm for new methods owes more to the internal dynamic of their profession than to a reasoned and knowledgeable critique of current assessment methods in mathematics. ISDs can stimulate us to review and improve our practice, but the review and the improvement is almost entirely a job for mathematicians. Maths 80%, generic 20%.

Knowledge and understanding of how students learn, both generally and in the subject

Many would query the inclusion of this topic in any teacher training at HE level - not because it lacks importance, but because it is such an open and underdeveloped area that it is doubtful whether any practical help it confers is much better than would be provided by sheer common sense and practical, well considered, experience. The rather banal concepts we meet in generic learning theory are far surpassed in the Mathematics Education literature (Tall, Mason, Poincare, TMHEBB, etc, etc), but this is also probably too much for the new maths lecturer. It is glib and ambitious to suggest that an understanding of how students learn can be conveyed in a few hours of workshops, especially if they are not subject-specific, let alone in such a way to be of practical usefulness in the classroom. The advice of an experienced maths lecturer will almost certainly be more useful.

Maths 90%, generic 10%.

Knowledge and understanding of the use of appropriate learning technologies

Again, whatever IT would appeal to the mathematics lecturer would almost certainly be better developed by mathematicians. The key here is in the descriptor itself - 'appropriate learning technologies'. Whatever is appropriate in maths is almost certain to be inappropriate for the historian. It is true that many ISDs are charged with promoting and providing training in IT skills, but these are usually at the generic office-based secretarial and administrative levels. You won't get much help with Latex or AIM. However, there are technologies that have a generic purview that may be useful in maths, such as the 'clickers', and some plagiarism software, and in these areas generic

provision can make a contribution.

Maths 70%, generic 30%.

Knowledge and understanding of methods for evaluating the effectiveness of teaching

There is much that is generic here, although the means by which, on a day to day basis, we check that our students are with us are more likely to be understood by the maths teacher rather than a generic staff developer. In any case the usual means by which the ISD provides input to such areas is by seconding the services of mathematics staff as peer observers, mentors, and so on. They may also be able to offer advice on such things as student feedback methods.

Maths 50%, generic 50%.

Knowledge and understanding of the implications of quality assurance and enhancement for professional practice

While ISDs may, institutionally, seem to have the expertise and experience here, as they tend to be involved with quality assurance across the university, and the professional development issues that arise from it, it is again the maths teacher who is best placed to understand and address this issue, in their context. The ISD can provide the information about national contexts and policies - for example if a QAA audit was due they could be very helpful, but this is a somewhat different issue to the training of staff. In fact any formal education in this area is bound to be mind-numbing, a like a two-hour lecture on filling in your tax form. The way to interest new lecturers to such things is to get them involved directly with assurance and enhancement activities, in the company of experienced staff, both generic and mathematicians. This is really an area which is best learnt on the job.

Maths 50%, generic 50%.

Professional values

In general the issue of professional values is a thorny one in the context of the generic/discipline-based divide. As in the case of the lecturer trying to incul-

cate particular values in their students, so it is very difficult to develop the lecturer's own values in regard to teaching as part of their professional duties. One cannot **instruct** someone to adopt particular values, one can only seek to establish an environment in which those values are highly regarded and communally shared. This can best be done within the lecturer's own department, where the lecturer spends most of their time, provided it takes its teaching seriously. And this is where the academic department must shoulder their responsibility. We hear from our respondents that ideas of good practice sometimes go out the window when they return to the department. This is the fault of the department, not the generic provider.

This aspect, the promotion of the sorts of values on which good teaching relies, represents perhaps the most important area for departmental training. The ISD may be able to advise the departmental leadership on the sorts of values that need to be promoted, and suggest ways of doing it, but ultimately the responsibility rests mainly with the department. And an ISD that is viewed with scant respect, because it continually overreaches itself by insisting on its responsibility for carrying out training that would be better left to academics, will find it hard to inculcate the kind of professional values we are speaking of. We believe that ISDs will strengthen their own position if they accept a more measured role in the training of new staff.

Respect for individual learners

An good ISD would be in a strong position to support departmental leadership in this area. All good teachers respect their students, or they wouldn't go into the game - except that in universities many staff go into the game for the research and not for the teaching, which they sometimes regard as a distraction. Prizing brilliance above all else, academics can be disdainful of weaker students. We believe that institutions should develop a clear ideology with which to oppose this. But who will develop it, and who will convince academics of its merits? Mathematics departments themselves may need help in revising their attitude. There is a lot that is generic here - a respect for students is largely independent of the subject. But the detailed features by which academics judge their students, the cognitive skills that they expect of, and value in their students demands a recognition by the ISD of the importance of discipline-based provision.

Maths 40%, generic 60%.

Commitment to incorporating the process and outcomes of relevant research, scholarship, and/or professional practice

In their generic networking capacity ISDs will have useful suggestions for this area from other subjects. However, at the detailed day to day level it is overwhelmingly again a departmental responsibility. The incorporation of the outcomes of mathematical research into the curriculum is evidently the job of a mathematics department. However, this should not be done at the expense of a balanced, inclusive, widely relevant curriculum (too often a young lecturer's idea of incorporating research into their course is to turn lectures into mini-seminars on their own interests). And it needs to be remembered when teaching maths to non-specialist students such as engineers that research processes as well as outcomes can be highly subject specific. For example research processes in engineering can be more inductive than the deductive processes used in maths. To an engineer the way some mathematicians teach their subject can be analogous to how a generic staff developer might approach training in the assessment of mathematics. So a balance has to be found in this area and the generic experience of ISDs can be valuable here. So far as the incorporation of research in pedagogy and professional practice is concerned this is again primarily subject-specific. Not only is there an active field of Mathematics Education with a long tradition, but also a long line of distinguished mathematicians have written on the teaching and pedagogy of mathematics. The MSOR Subject Centre has nationwide links to both Mathematics Education and experts in professional practice, as well as extensive relevant resources.

Maths 70%, generic 30%.

Commitment to development of learning communities

Generic input can be useful in this area, because of its dependence on affective issues, and again we can learn a lot from other disciplines. ISDs often put on workshops in topics like small group teaching, which can provide some useful ideas. There are also good examples of maths-based provision in this area - see for example [3], [30].

Maths 50%, generic 50%.

Commitment to encouraging participation in higher education, acknowledging diversity and promoting equality of opportunity

There is no doubt that ISDs have played an important advisory and facilitating role in the widening participation agenda that has seen student numbers rocket in the last couple of decades. Academic departments have also played significant roles in outreach activities, and they are the ones that have had to bear and steer through the curriculum development and the new teaching approaches arising from this increase. And this is at the same time as there has been dramatic increases in demands for research output, putting strains on the resources available for teaching. Through the vast amounts of work on the transition to university (see [7] for a review of departmental practice in this area) mathematics departments have played a leading role in addressing the retention issues arising from widening participation. Once again, departmental attitudes are a more effective promoter of professional values than an ISD workshop, though a workshop might set the institutional context and broker exchange of ideas across disciplines.

Maths 60%, generic 40%.

Commitment to continuing professional development and evaluation of practice

It is the leadership provided within a department that determines the extent of this commitment on the part of its staff. An ISD is only going to be able to contribute to the development of an ethos of good teaching with this support. However, much of this is generic and ISDs do have an important role to play here. Maths 50%, generic 50%.

Conclusions

Not all training can be generic, and neither can all training be discipline-based. It is also clear that no quantification of a balance between the two can be acceptable to all, or be applicable to all departments. Our clumsy attempts above are not hard and fast conclusions about the ‘right balance’. Our aim is to highlight the need for a wide-ranging discussion about the issue, and to offer a relatively crude paradigm to start off the debate – a

detailed analysis of the PSF as manifested in its application to training within mathematics teaching.

The conclusion of our considerations on this would seem to be that there is currently an imbalance in the focus of provision, with a need for a stronger emphasis on the mathematics components of training. This has implications for mathematics departments, both in the responsibilities they bear and the resources they deploy in this area. Just as we would expect generic providers to enter into such a debate with strong evidence-based arguments, so we expect the same from mathematics departments. It is not sufficient to criticize current provision, as many do. It is necessary to argue the case for alternative provision and be proactive in supporting it [20].

Unhappily, later sections in this chapter will contain overwhelming evidence of a schism between generic and discipline-based provision. Far from working together, the ISDs and the academic departments often have little liaison, and are rarely satisfied with each others' contribution to the training of new staff. So far as most UK university administrations are concerned, responsibility for interpreting and implementing the PSF lies with the ISDs, since traditionally they have been responsible for training of university staff.

Historically academic staff training was developed by academics involved in general educational research or in the humanities, with a few notable exceptions such as the physicist Lewis Elton. They developed generic materials and training programmes under the auspices of the Universities and Colleges Staff Development Agency, that later evolved into accredited training for teaching in HE and finally into the HEA PSF. During much of this evolutionary period, other academic departments ignored most of what was going on, because they focused on research and did not believe that generic teacher training was of much value in their disciplines. Only since the government's requirement for academics to be trained for teaching, expressed in the TQA and Subject Reviews, and culminating in the White Paper quoted earlier, have academics been forced to acknowledge the need for teacher training. Meanwhile the generic providers located in the ISDs have been consolidating their position as the *de facto* providers of such training, having established their professional credentials by turning this training into a separate enterprise in itself, divorced from discipline or practise-based provision.

The dissatisfaction of departments with the generic locus of provision has not escaped even national policy makers, who clearly recognise the need for discipline-based input in the latest documentation, and in particular in the PSF. What is becoming evident however is that most ISD provision does not

recognise this aspect of the strategy, and most academic departments have not risen to the challenge of providing or even influencing the training.

The result of this mismatch between imposed requirements and the realities of educational practice is that all too often, the ISDs find themselves deeply unpopular, contractually obliged to deliver generic training to new staff who see little value in it and who resent the time it takes them away from research. The effects on teaching are largely negative. Staff time is being wasted, the White Paper's call for improved teaching is not bearing fruit, and the resources and skills of the ISDs are not being put to good use.

²

2.3 Teachers and researchers

One might hope that the interests of students, as educational consumers, and of academics, as teachers *and researchers* would naturally and inevitably prevail. However, we see two factors which work against this happy outcome. One, described in the previous section, is the monopoly which ISDs have been given over staff training, and which experience across the sector shows they are unwilling to relinquish, for the usual institutional reasons. This is coupled with a widely held image of academics as unwilling to give priority to teaching over their research. The second, perhaps less present in our thoughts around these issues, is the unwillingness of academics themselves to play an active role in training their new colleagues - perhaps partly for the above reason. But of course there are other reasons: most senior academic staff in UK universities began their careers at a time when new staff were given no training and were expected to work things out for themselves. The concept of overt or explicit staff training is in some ways foreign to institutions which take academic freedom as an axiom and which operate on a basis of collegiality and mutual respect.

The danger of collegiality as a *modus operandi* is that it can too easily turn into happy ignorance of what our colleagues do. Increasingly, we are called upon to deliver high quality teaching to a very wide range of students, and we will be assessed on the quality of our teaching. As emphasized in the previous section we believe that providing our new colleagues with appropriate training *is*, in a large part, the responsibility of academics. If we do not meet this responsibility, our new colleagues will continue to receive generic

²For a vivid and provocative view on the issues discussed in this section, see [20].

training which, as argued above and demonstrated in surveys of staff experience reported in Sections 2.4 and 2.6, is unequal to the task of achieving the aims of the PSF or, more importantly, providing the students or the country with the service required.

For departments to start to train their own new staff will be a challenging new development. But it only has to happen once. Once the new structures are in place, and provided they are installed with sufficient thought, they will recede into the background, we will have improved the teaching of students in our department, and we will have improved the early experience of our new colleagues.

In this book we hope to suggest ways in which a department can start to develop its resources in staff development. We hope to encourage rather than prescribe. After all, we are still learning. We strongly believe that every system must be allowed to develop and evolve. Here we aim to help departments find a place which they can evolve from.

We offer two kinds of guidance. The first is a description of some of the possibilities for departmental training, some tried at Warwick and elsewhere, some as yet untried. We emphasize its integration into the day-to-day activity of teaching, because that is how we believe it will be most effective as training, and because activities that draw in existing staff can help to generate interest in teaching across the department and increase communication between new and established staff. The second source of guidance is in the voices of lecturers themselves. We have collected a number of short contributions by academics currently working in the UK, on two distinct themes: from the older and more established, some thoughts about their own experience of teaching, which are discussed in Section 2.5, and are available in full on the MSOR website, at XXXX (look under “Article support pages”). We also have a number of contributions from academics two or three years into their first UK teaching appointments, with ideas on what kind of training they found useful, or would have found useful had it been available. These are discussed in Section 2.7, and again the full responses are available on the MSOR Network website at the above address. We have also looked in detail at the training experiences of a small number of new lecturers, which are described in Section 2.6. Again the full scripts can be found at XXXX. We cannot claim to have carried out a scientific survey. On the other hand, we believe strongly that teaching and learning, as the activities of individuals, are as varied as those individuals themselves. Just as we believe that lecturers should pay attention to students as individuals, we believe that the voices of

individual lecturers should be listened to.

We repeat: we do not believe that *all* training of new staff should take place in academic departments. The training of teachers of maths in HE must contain both generic and discipline-based components. We see a significant role for ISD's because they are home to skills that subject departments cannot expect to have, and which we can draw on. Training for mentors, advice on peer observation, procedures for ratification of qualifications and previous experience - all will be helpful to academic departments seeking to provide appropriate training for new staff. We might even imagine that once a significant part of staff training migrates to academic departments, ISDs will begin to advise those departments on the training they deliver. Moreover, there is a long and varied list of aspects of training that are entirely generic - counselling skills for tutors, voice training for quiet or nervous speakers, time management and budgetary skills, and so on.

We hope that by recognising and highlighting the areas in which ISD's may be expected to have skills that academics do not, we will contribute to liberating their staff, as well as ours, from the current unsatisfactory situation. And it is unsatisfactory! In the next section we look at the current situation, as shown by the results of a survey carried out by the London Mathematical Society in 2005. In Section 2.6 we see the same problems arising again, in repeated complaints from staff on the receiving end of generic training.

2.4 The LMS survey

In November 2005, the Education Committee of the London Mathematical Society carried out a survey of staff training in mathematics departments UK universities ³. After being told that

... the EPSRC/CMS International Review of UK Research in Mathematics [found that] there is concern, in some cases expressed by the participants themselves, about the burden and content of the academic practice courses now required to be attended by new academic staff,

³We are very grateful to Niall Mackay and Chris Budd, of the LMS Education Committee, for permission to quote from the survey here

the Heads of UK Mathematics Departments were invited by the LMS Education Committee to comment on these courses, in order to help the committee decide whether and how to take the matter further. Responses were received from 20 old universities and 5 new universities (former polytechnics) - a majority of the providers of single-subject Mathematics degrees. In all except for one, the training was almost entirely generic. Two reported satisfaction with this generic training; the remainder were critical, some extremely so. Here are some illustrative quotes:

- “New staff are expected to attend many courses on a range of topics, but the universal view was that the vast majority of these courses are a waste of time.”
- “The general nature of the courses severely dilutes their usefulness.”
- “On the job training is more useful than attending courses.”
- “No-one ever asked the department what kind of new training we would like our new staff to receive. If we were asked, the answer would be something very different from the current programme.”
- “Young colleagues find these courses excessively demanding in time for the value if any. They ought to be more practical in nature, take up less time, and be subject/discipline specific.”
- “The ridiculous hoops that they have to jump through has certainly been the reason that we have lost, at least, two young members of staff. The main problem [is that] the material is neither well presented nor relevant to Mathematics and Statistics. At _____ the courses have been introduced without any consultation (as to content) with the Heads of Schools. There are some excellent courses put on (e.g. [...] by the Maths LTSN in Birmingham), but that course is not recognised by our university as an alternative to their university-wide generic course.”
- “I have had long years of University Education (as most academics do), and of course I have had experience of bad academic teachers. Therefore I strongly support the concept of instructing new academics in advancing their teaching skills. [...] However the discussion [in the generic course] is often not relevant to mathematics.[...] Since the course organisers have to cater for academics from areas as diverse as history of art and engineering in the same session, it is clear that a relevant discussion to such diverse areas can often be degenerated to cliché generalities.”

- “New (mathematics) lecturers are different from new lecturers in lab-based sciences - they usually have 3 or more years of teaching experience, experience giving talks at international conferences, and work independently rather than in teams. They therefore find the courses patronising as well as time-wasting, and so get nothing from them as they spend the whole course angry.”

To set against these opinions criticising generic provision, we mention

- “I have learned many things and I have gained new ideas from interacting with academics from different areas. This has helped me obtain a more integrated opinion about the concept of academic teaching and assessment.”
- “I have obtained a great deal of practical advice from the people that run the course, especially on issues of good lecturing practice and good practice on interaction with the students.”

To summarise the strong messages coming from the LMS survey:

1. Mathematicians see some need for training in teaching, but few academic departments have been consulted by their university’s ISD on what kind of training they want their new staff to receive.
2. The generic training they do receive is believed to be of little or no value, especially in relation to the considerable burden it places on new staff.⁴
3. Reports of generic training workshops and seminars paint a picture of extreme generality and theory which is of little value in teaching practice, together with frequent invitations to reflection and self-questioning which do not make up for lack of real content.
4. ISDs are unwilling to relinquish even part of their hold over the training programme, by allowing some of it to be replaced by the universally praised MSOR Subject Centre Induction Session.
5. Training on the job is believed to be much more appropriate to the needs of mathematicians.
6. Contact with young academics from other disciplines is valuable.

⁴See the discussion of the length of training in Section 3.6.

7. Staff in ISDs have skills which are of value when used in practical one-on-one advice and guidance.

2.5 What does the mathematics community think?

What a silly question! Both authors have been around long enough to know that if you get any group of lecturers talking about teaching you will find extreme views of all kinds, and a dearth of common ground. But having the impertinence to write a book about training teachers we are obliged to take the question seriously. We asked a number of colleagues to write something about how they learned to teach and what they thought about training of teachers. This was not in order to gather evidence in support of any ideas we had, indeed we were pleased to find healthy disagreement on many areas. The idea was to crystallize key questions that arose from the contributions and to get an idea of the breadth of views one might encounter. The pieces may be found at ([Network url](#)). Here we are going to pick out the interesting issues that emerged and add our comments about how this book addresses them.

Should university teachers be trained at all - isn't it all common sense and a matter of opinion?

We doubt that any of our respondents really think that new lecturers should not receive some sort of training. However some come close to the common view that good teaching is just common sense picked up on the job and that 'experts' in teaching have little to tell us that we couldn't figure out for ourselves. This is often softened into the claim 'There are no axioms or theorems in teaching' which is then sometimes taken in the nihilistic spirit that we can teach however we like. Our view is that a combination of mentoring, teaching observations and honest engagement with the issues and difficulties of teaching can contribute significantly to its quality.

Who should do the training?

The LMS survey shows widespread and consistent dissatisfaction with the current arrangements. We believe that this is inevitable. Of course ISDs

find it impossible to provide a useful training. Concerned only with the generic aspects of teaching, and unqualified to comment on its content, they inevitably focus on the medium to the exclusion of the message.

Some might claim that ISDs address message when they cover theories of learning, but generally their models are so anodyne (e.g. the Kolb experiential cycle) as to be useless in practice. There is a well established field of Mathematics Education which is streets ahead of generic learning theory, and, through the MSOR network, is already reaching beginning lecturers. ISDs have their role, but one that is far more limited than is realized in current practice.

So far, so good. We probably have you on side - these guys are damn right, this generic stuff is a load of rubbish - many of the respondents confirm everything we thought about them, waste of time these staff development courses. Well, we could be about to lose you. So what is **your** solution, who **should** do the training? How much effort does your department put into teaching? How much effort is it willing to put into helping new staff with their teaching? As one of our respondents notes, there is no forum for discussing and improving teaching in their department. We suspect they are not alone. It is not always easy to get mentors in departments for new staff, and often they are not trained and have only their experience to offer. And what happens to anyone who expresses an interest in teaching? They get more of it, or get loaded with some administrative job such as senior tutor, admissions officer, etc. Worse, as one of our respondents generously opines, they are often regarded as people struggling with their research and seeking solace in teaching in the company of other failures needing a role for themselves.

So departments too have to change. And come to that, what real expertise does the average academic have in teaching? Expert knowledge in a subject is only a part of being able to teach it. Mathematics Departments too need to develop their skills in training new lecturers. If the department really believes that there are aspects of training that are best in the hands of practitioners rather than the ISD then they must shoulder the responsibility and workload involved.

What training is needed?

We hope that this book will give some guidance in this area. Our respondents give us many ideas. One highlights the important point that often new staff

don't know the questions to ask, even if they are in a friendly environment where their questions are welcomed. The trainer or mentor should know which questions are likely to arise and try to anticipate them in the initial training. In doing this they risk coming out with things that some new staff will think obvious and banal – new lecturers often complain about being told the blindingly obvious. The risk is less when a small group of lecturers is being addressed and the trainer can respond to the individual members, rather than trying to cover all possible topics.

Many respondents volunteer topics they think should be covered in training, and these are numerous, varied and sometimes very specific to the individual, such as the advice about speech training for foreign lecturers. The point here is that any training must be flexible enough to analyse and address a wide range of needs in an efficient way. For example, the sort of speech training described by the respondent might be impractical for a department to organise for a single member of staff, but here is an instance where the ISD could be useful. Most of the issues described are generic and it might be practical to mount such provision for a number of lecturers from different disciplines with similar problems. Everyone's need are different, but some overlap - as another respondent says, horses for courses.

An interesting feature of many of the suggestions is that appropriate advice is already readily available in the literature - such as setting fair examinations. So a part of any provision will consist simply of guidance towards the literature. And this is not onerous, there are no more than a handful of books on the general problems of teaching maths in HE and no one who considered themselves serious about their teaching should balk at such a reading list. On the other hand some topics are specialized yet widespread and at the moment do not have an extensive literature. Our survey amply illustrates a case in point - the high number of foreign lecturers and their need for induction into the UK system and culture. Across the UK this amounts to a significant clientele and calls for a nationwide response. This is something that the MSOR Network could take in hand in supporting departments through workshops, one-to-one advice and so on.

The conventional device for defining the sort of training needed is the set of learning outcomes of the programme. There are any number of these extant, and each department will need to frame their own to suit local circumstances and needs. We will discuss this issue in Section 3.7. Some of the suggestions are surprisingly specific - for example one respondent devotes his entire response to dealing with the 'snare of coverage'. Again, this is a

common issue, and is in principle easily dealt with. One of the things the piece shows is how outside influences can push a lecturer in directions that go against his better judgement.

How should the training be done?

‘Please - no university training’, succinctly summarises the discontent of many academics with how training is often conducted these days. Our survey is littered with comments that criticise both the content and nature of training courses. Many of the practices mentioned are deemed inappropriate to maths teaching, and indeed seen as doing it positive harm. As in all debates there are (at least) two sides. Some of the criticisms are fair - for example the preoccupation of ISDs with essay type issues rather than problem solving, and the unthinking importing of ideologies appropriate to other subject areas, as in ‘there is no wrong answer’. But the blanket rejection of all training is, we hope, the result of despair rather than of complacency. Surely few of us would reject the view that teaching is worth discussing, that it can be improved, and that it can be made more interesting and enjoyable for the lecturer?

So what exactly is it about ISD training that raises hackles, and how can academics do it better? This book contains much on this, from the perspective of many practitioners who care for their teaching. However, there are some overriding messages that come across not only from our respondents but from mathematicians everywhere, especially new lecturers undergoing training.

Of course the most obvious complaint is the lack of mathematical input into most generic courses. The remedy for this, via departmental training and use of MSOR Network expertise, is the *raison d’être* of this book.

Another justified complaint relates to the nature of the assessment by such things as essays on manufactured topics, which are seen largely as jumping through hoops to satisfy the ISD tutor. This verges on insult to young professionals. We know of no other professional field that subjects its graduate (let alone postgraduate) recruits to such artificial treadmills. Our principles of training (Section 3.2) are designed to avoid this. In the course of their normal duties new lecturers have ample opportunities to write reports on their activities and their rationale in lieu of ISD type essays. Of course, the ISD will then not be qualified to assess them on its own, and the department has to shoulder part of this responsibility. Furthermore the assessment of

such reports would be done via the professional judgement of the staff allocated to the task. This would be exactly how we assess the quality of any report submitted by a member of staff for normal departmental purposes - a 'marking scheme' for such things would be unworkable and unnecessary.

The above is in fact one manifestation of another common complaint, the high workload involved in much training. Of course some of this is accounted for by the artificial nature of some of the tasks and assessment, noted above. But there is also the burden of some ISD workshops and courses. Some of these are really a waste of time, taking an afternoon to convey points that could be dispensed with in minutes and an A4 side. The pace and level of presentation is often more appropriate to weaker students than for highly qualified professionals. There is no reason why educational training provision should not be presented with the efficiency and speed expected of a research seminar. In fact if it embodied some of the intellectual quality of a research seminar, most probably more of us would sit up and take notice. Of course, not all ISD workshops deserve this criticism, but where they do, the academic departments have a responsibility to make representations to the ISD and ensure that their staff's time is not wasted. On the other hand, lecturers should not expect an easy ride in their training. We have already emphasized that teaching is important and requires serious commitment and effort to do well, and, for most new recruits, will be a major part of their job. One of the problems of training is that the required time commitment is not explicitly spelled out and is not accommodated in the lecturer's load, and mixed messages come from different quarters. Elsewhere in our surveys we have come across new staff told not to spend long on their teaching certificates because teaching detracts from research. Others find themselves under pressure to pass the certificate as a requirement for passing probation, even though they have little or no teaching in the first years of their new post! The question of workload is important and needs recognition by everyone involved with training of new staff. We will discuss this in Section 3.6. It seems that many universities have acceded to the government's requirement for staff to undergo training, but have not made proper allowance for the training either in their new recruits' timetable, nor in the budgets they allocate to provide it.

Is pedagogy any use?

One thing that can be relied upon in any discussion of teaching amongst academics is visible contempt for pedagogy or educational theory. And our respondents do not disappoint. Pedagogy shares vitriol with ISD provision, with which it is often, incorrectly, identified. The uselessness of pedagogy follows from the axiom ‘There are no axioms or theorems in teaching’. It is true that a great deal of so-called educational theory is valueless - like a great deal of current research. One of our respondents expresses this with a nice back-hander ‘...educational literature, ... (like the relative profundity of research papers in mathematics) ... is a mixed bag’. But just as in mathematics research there is a lot of good useful stuff - the difficulty lies in finding and interpreting it, and also in having the professionalism to devote some time to it. As already mentioned, there is Mathematics Education literature on the topics of some of the queries raised by our respondents. But there is no doubt that more effort is needed to bring together theorists and practitioners in maths teaching and there are already moves in this direction – see for example [26] and [2].

What support do new staff need?

Many of our respondents testify to the value of the support and input they received from colleagues, not always in any formal way, and not always welcomed at the time. Perhaps this is an occasion where the ISD dictum that there are no wrong answers, or no stupid questions could be adopted fruitfully. The first requirement for any new member of staff is that they should be able to feel relaxed and to express their ignorance and concerns without embarrassment. We find that many new lecturers speak highly of the friendly, supportive environment they joined, and every department should strive to provide this. Today it is usual to allocate at least one mentor to a new recruit, and this is an important role. The mentee needs to feel totally confident in the mentor’s hands, and the mentor needs to have the power to further the mentee’s best interests. However, this does not mean the mentor should (‘as an axiom’) be on the side of the mentee. The mentor’s (as everyone else’s) priority is to enhance departmental provision for the students. The mentor should feel able to provide constructive criticism without fear of resentment.

What about the message?

In the many suggestions for content of training it will be seen that most of them actually refer to the **media** of teaching - voice training, board work, use of notes, structure of lecture and so on. There is little reference to the **message**. By this we do not mean simply the content, but more importantly the way of putting across the content, the skills of explanation, motivation, etc. The ‘how to teach something’. Two different people can spend five minutes lecturing on a difficult topic with identical media, with one being incomprehensible to the point of being offensive and the other being crystal clear, exciting and a joy to listen to. Only a few people refer to such things, but this is really the core of good teaching. We find this in many encounters talking about teaching. Often the medium is at the forefront, and it seems to be assumed that the message just takes care of itself - ‘Surely, all you have to do is tell them how to solve a second order differential equation with constant coefficients ...?’. But it’s how you tell them. This is where the experienced, dedicated teacher really comes into their own. They can provide guidance and suggest ideas for putting difficult topics across, highlight the sorts of places students get hung up, and so on. You don’t have to be a ‘natural’ to benefit from this. If you care for your students and are willing to learn, you can be trained as well in the message as in the media.

Respect for students

One of the most depressing messages we find coming across both from our respondents and wherever we go in the Mathematics HE sector is that there are too many academics who, far from respecting their students, regard them as a nuisance and distraction. This situation has worsened with the skewed UK obsession with research, and the influx of foreign lecturers who have difficulty adapting to a different culture in UK HE. Of course, there is no room for any sort of negative attitude towards students. They do not have to be as good, as interested, or as committed to maths as you are, and the vast majority of them are not. Your job is to teach them, and provided they do what is required for their studies, which the vast majority do, then you have no cause for complaint and have to respect them as you would any large group of adolescents. But it is really the job of the Head of Department and others responsible for student welfare to set the tone and provide leadership

in this respect. It is very easy to go with the herd and join the staff in ranting about the shortcoming of students, but it is unprofessional and bad leadership. The best Heads of Department support students, respect them and expect their staff to do the same. An atmosphere of collegial pride in the job should make it clear that any adverse attitudes towards students will be severely frowned upon.

Marking as a chore

It is almost traditional for academics to regard marking and the examination process generally as a poor second to sweeping the streets, to paraphrase one of our respondents. We all joke about it. Yet it is one of the most important things we do. We suspect that in fact many academics secretly enjoy marking - in principle it is the one activity where we actually find out how much, or how little, we have changed our students. It can be quite nerve-wracking, as you begin to feel that you are going to have a lot of failures, though often it comes out right in the end. As we will see later, assessment generally is a big concern to new lecturers, and it does not help if experienced colleagues, well practiced in producing acceptable results, show disdain towards the process, or minimize its importance. This is another area where Heads of Departments and experienced colleagues need to set a responsible professional tone and provide plenty of support for new staff.

In summary

The responses to our survey and our comments above give a picture of the training issues that are at the core of maths teaching. It represents what one might hear amongst experienced academics in a typical common room chat. Probably well established, with many teaching years under their belt, able to reflect on their early days, they are perhaps conscious that things have changed, and that we are almost in a different profession now. So what about more recent appointees who have just struggled through their probationary years and had to run the ISD gauntlet or balance priorities in a way that the old hands perhaps did not - what is the experience of new lecturers?

2.6 The new lecturer experience

Many new lecturers will have a different experience to that of the senior colleagues they join - the academic world has changed a lot in the last decade or two. It is therefore worth putting ourselves in their shoes before we move on. In preparing this book we interviewed a number of new staff in UK MSOR departments on their experiences when they join a department. The full texts of the interviews can be found on (Network url), and here we summarise the messages coming across.

Support received

Whether they join a large or a small department it naturally makes a difference how the new lecturer is welcomed into the fold, and many testify to excellent experience in this respect, describing warm helpful staff. A minority mention unease at being able to discuss their problems, feelings that teaching does not take a high priority, or little proactive support. The point was also made that even when staff are helpful, the new lecturer does not always know the right questions to ask, and is not always able to foresee problems that might arise.

- *‘...was formally assigned a mentor within the department, but found all the staff so friendly and helpful that I could go to anyone for help and advice’*
- *‘... felt that the department could have been more proactive and responsive, but always had someone to go to if needed’*
- *‘... was formally assigned mentors, one for the School and one for the ISD centre, who shared teaching observations and other functions. However, the greatest help came informally from colleagues’*
- *‘I find I can discuss anything I need to with my colleagues, who are all very helpful. But part of the problem is I don’t always know the questions to ask because of unexpected occurrences. As an example, I only learned that I had been allocated projects to supervise when a student arrived to tell me I was his supervisor. The department does not do a good job of anticipating the new lecturers’ needs’*

- *‘Although I learnt a great deal at the Induction Course, all the good advice goes out the window when I get back to the department. For example, in my previous university I had learned to make the students think for themselves doing problems, but at my current institution such work was regarded as practice for the exam, so as to keep failure rates down. As a colleague remarked, “Wonderful ideas, but it all goes out the window when you get in front of 40 kids”, adding that trying out new ideas is fine, but not if all the students fail’*
- *‘I was surprised at the department’s lack of formal support for new lecturers. In particular this meant that a maths-based training was not possible’.*
- *‘I was told not to spend much time on it as in a research-led department teaching detracts from research’*

Foreign staff

The plight of new foreign staff is sometimes acute. Often, they may have no idea of UK HE teaching culture, the standards to be expected from students, the conventions surrounding examinations, etc. Some report good proactive induction in such things, with the department keen to also learn from their experiences, while others had to learn the hard way and found the environment mystifying in some cases.

- *‘No one alerted her to such things as the weak background of students, which she had to learn the hard way. UK students, having prescribed levels of school maths made them easier to deal with than many foreign students’*

Inconsistent expectations

There is a wide range of expectations on what training the new lecturer has to undergo. For some the ISD Teaching Certificate is mandatory, and the quality and usefulness of this varied widely. Others obtained partial exemption through APL. We found no one that was enthusiastic about such courses, some of which had virtually no link with the department at all. Some new lecturers seemed able to avoid completion of the ISD Certificate. Others avoided it by joining the HEA (then ILT) via the individual ‘Experienced

staff' route. Few ISD Teaching Certificates had significant mathematics input and one new staff member was told that there is nothing special about teaching mathematics.

- *'Despite already having experience of teaching no APL was given and she was still expected to do the full university induction course of roughly five days, and also to attend the MSOR Network Induction Course'*
- *'The central ISD uses no one from the department, so there is no infiltration of discipline-based elements into the ISD, which only provides generic courses, focused mainly on explaining how the University works'*
- *'He had to attend the mandatory ISD teaching certificate despite many years of teaching experience'*
- *'The discipline-based input was very low ... but it had an "Action Research Project" which enabled him to obtain ILT Associate status'*
- *'Most of the Teaching Certificate is useless, with no maths input - the trainers do not believe in subject-specific teacher training, and did not believe there was anything special about teaching maths'.*
- *'He was supposed to have completed the Teaching Certificate as a requirement for getting through probation, but he has already passed that hurdle and he now believes it would be a hurdle if he wanted promotion to Senior Lecturer'*

Needs assessment

Few staff had any formal assessment of their needs, or benefitted from any APL. No one mentioned any sort of formal appraisal, although many spoke of the avuncular role played by a head of department or other member of staff. Most had a reduced teaching load in their early years, and freedom from admin duties.

- *'APL was at the discretion of the Head of Department – newly appointed professors, for example, don't have to do the Postgraduate Certificate'*
- *'Because of previous teaching experience, he is doing a shortened version of the University Postgraduate Certificate'*

Mentoring

Almost all new staff interviewed had been allocated a mentor (or two!), but experience on this was mixed. Often there was no choice in the mentor and while some were trained experienced staff, some institutions provided no training for the mentors at all. The roles of the mentors were also variable, some sat in on lectures, helped with exam setting, etc while others left it at the cosy chat stage.

- *‘She had no say in the selection of the mentor, who received no training for the role. The University ISD would not train the mentor, and she suggested that the MSOR Network might put on a session on mentoring new staff since she was shortly to take on a mentoring role herself’*

Opportunities for discussion about teaching

Most new staff found little opportunity to discuss teaching in a structured way. Where the department held meetings related to teaching these were usually reactive and perfunctory. The only dedicated workshops on teaching matters mentioned were either those provided by the ISD or the MSOR Network’s Induction Course for new lecturers, the latter providing the opportunity to see what goes on in other institutions.

- *‘So in general the teaching workshops are reactive, responding to events as they arise’*

Assessment of training

Except for those doing their ISD Teaching Certificates, whose comments were overwhelmingly critical of the nature and amount of artificial assessment, no one was conscious of any assessment of the training and support they received within the department. There may of course been implicit assessment through such processes as appraisal and personal development review. And there have been instances where for example a lecturer was able to change their mentor through informal means. But aside from such informal processes there seems little oversight of the quality of support for new lecturers within the department.

In summary

The above gives a realistic picture of the environment a new lecturer in mathematics faces these days, in the UK. The varying degree of support from within their department, the demands of balancing research and teaching in an uncertain academic world, the possible requirements of fulfilling institutional requirements by attending possibly useless ISD courses, and the difficulties of teaching a student body with unfamiliar attitudes and priorities all serve to make the new lecturer's task daunting. The role of the department in underwriting their training is therefore paramount. Let us now look at what the new lecturers themselves tell us about the sorts of things they would like their training to address.

2.7 What do new lecturers want?

We have surveyed seventeen lecturers a few years into their first UK post. Most of them were contacted because at some time in the last four years they had attended the Induction Course run by the MSOR Subject Centre in Birmingham University. The remainder are colleagues of the authors. Each was asked to describe what training they found useful, and what training they believe they would have found useful if it had been available. The full responses are available at (Network url), and in this section we distil the main points made. It should be remembered here that by the very nature of the job, most respondents concerns will usually be of an immediate nature - almost fire-fighting. Therefore the areas discussed below must be regarded as minimal training requirements, which in a proper training programme will be supplemented by objectives of a longer term nature to help the lecturer develop fully professionally.

Setting and marking problem sheets and exams

Half of respondents wanted more help on **setting and marking** problem sheets and exams. This is not surprising. Assessment is vexatious even for experienced academics. For the new lecturer it may well be the first time they have set work for someone else - they may well have 'taught' before in tutorials for example, but possibly never set an exam before.

- *'Interesting to see how things, such as setting exams, are done at other*

universities'.

- *'Advice from mentor about handling a very difficult marker'*
- *'Summer examinations - what is the usual process of setting these exams, what is the format of these exams? Resits? Standardized tests? How do test scores influence admission and thereby quality of students?'*
- *'Setting homework problems and exams seems easy, but took a surprisingly long time to do. I think I will put even more effort into the homeworks next time, as the students didn't always seem to learn as much as I'd hoped. I think I've also learnt a lot about what are "good" or "bad" questions from tutoring and marking other lecturer's homework problems. This seems to be an area which is vital to student learning, and is very "maths specific", so badly handled by generic training'*
- *'I had to write an exam paper and to decide how many tests to give before the start of teaching. It was not possible to ask the advice of previous lecturer as she was on leave. To make things worse, I was not getting any direct feedback from students, as the system was working in the following way: students would send complains to their tutors, and tutors would send complains to the level coordinator. I felt intimidated and had no courage to show any initiative to change the situation. I knew I could approach someone from my Department about my problems, but at that time it seemed to me that this would be considered as a weakness and I would be branded as a not that good a lecturer'*
- *'Writing exams - how to write them in such a way that you are, in a single exam paper, testing all of the students - the weaker, the moderate and the stronger ones - rather than just some of them. What I mean is that if the paper is too easy, you cannot distinguish between the strong and the very strong students, and if it is too hard, the weaker students all fail. Questions need to cover a range of difficulty'*
- *'I came from the Faculty of Mechanics and Mathematics at the Lomonosov Moscow State University. At the end of 2005 I moved to the School of Mathematics at the University of Birmingham. So, I have had 15-year experience in teaching mathematics on the university level. Among training for new staff, I found the training in the assessment system as*

most interesting and useful. I would like to note a few features which were new for me:

- 1. impact of continuous assessments on the final mark,*
- 2. splitting questions into parts,*
- 3. dominating practical questions in theoretical modules,*
- 4. the prevalence of written assessment.*

In comparison with the Russian university assessments, the British system is more formal but it provides the equal rights. In the Russian system where oral assessment is used, the examination has a personalised form but, at the same time, it is the part of the teaching process. Written assessment does not allow teacher to evaluate how student understands module content as a whole. Students often can derive some formulas but they do not understand the course methodology. I think that the oral assessment could be applied in advanced courses'

- *'The MSOR Induction Course in Birmingham was my first exposure to UK Higher Education: having moved to Britain only a few weeks previously, I was still a very recent arrival when I was encouraged by my School to attend. The Course itself touched on many of the topics I expected to hear about in this context. Particularly useful were the modules on presenting and assigning relevant examples in class and on marking and providing feedback to students. Both modules involved group work on actual examples and assignments as well as ample time for discussion, which greatly helped me in digesting the large amount of material presented. The module on online assessment proved more relevant than I had expected, since my institution has since started debating the introduction of that type of assessment. I returned home from the Course not only with a slew of information, but also with the comforting realisation that my situation was not unique, in that there are scores of beginning lecturers each year facing the same challenges as me'*

UK culture

Recently there has been a dramatic rise in recruitment of foreign lecturers. Understandably many of these have difficulties adapting to the differences in

UK HE culture. This is exacerbated by the fact that inevitably the majority of such recruits come from top institutions in their own country. So they not only have problems adapting to the structural and organizational differences in the UK, but also they encounter much weaker students, needing more support, than they are used to. Our respondents give vivid testimony to the difficulties that can arise.

- ‘UK culture to “student culture”. E.g., I had to learn the hard way that students here are more passive (and less polite!) in the classroom than in the US’.
- ‘how British exams work – again shockingly complicated for someone moving here from, e.g., the US’
- ‘Having completed my PhD in Statistics in the USA I was rather unfamiliar with the British University system, but have had some teaching experience. My main concerns about being a new lecturer therefore had almost exclusively to do with the British University procedures and system. In particular the concept of summer examinations, the fact that students do not have text books and are given little or no homework as well as the very different prior knowledge of students, required some getting used to’
- ‘In retrospect I believe that I, as a lecturer that grew up under a different educational system, would have greatly benefited from a short, maybe half-day, workshop on the British system’
- ‘In later training, emphasise facts and applications over theory, and remind outside speakers to define jargon. For example, it is useful for those of us new to the UK to be told about how A-levels work, but any explanation needs to remember that most of us know nothing about it, or how to calibrate what an A means. Similarly, remember that those of us new to the UK don’t have the same opinion as to what an assignment worth 67 is, or know what quality of work deserves a first’
- ‘Three things new mathematics lecturers in the British system should know: Don’t be surprised when tutees seem to be only interested in their marks. Most students in Britain have gained their university admission by obtaining between 3 and 5 A-levels at high school. To be admitted for Mathematics in Warwick two A-levels have to be in Mathematics.’

This means that many of our students had very little choice when they decided which subject they are going to study at university. Since pupils at school choose their A-level subjects at the age of 16 and many mechanisms strongly encourage them to pick Mathematics it shouldn't come at a surprise that many of our students don't really like Mathematics. Don't be surprised if tutees refuse to participate in mathematical discussions. Both A-level and university degree marks are overwhelmingly based on written exams. Moreover, students are almost never encouraged to practise the correct use of the technical language. In many cases this means that students fail to enjoy mathematical discussions during tutorial meetings and refuse to participate actively. Helping them to develop the courage to express their mathematical ideas with confidence in front of others is very rewarding for the students but not easy to achieve. Don't be surprised when students are passive in lectures and vigorously demand scripts. There is no mid-term culture in Britain, i.e. students revise for the final exams not before the end of the second term. This means that many students follow the content of the lectures only in a cursory way and spend little to no time on revision or homework while attending the course. Hence, it is important to provide them with a very good set of notes and self-explanatory homework, i.e. problems that can be done without additional oral explanations'

- *'When I started lecturing in the UK I have already had an experience of teaching from post-soviet university, and this at the beginning seemed as a certain barrier I had to overcome. In my previous experience, lecturing was oriented towards more academically able students. In the UK, lecturing is a totally different practice: one needs to earn the respect of students, to engage their interest in the subject, to encourage weaker students, to employ nonstandard ways of learning and comply with the strict procedures and rules'*
- *'Here are some thoughts on teaching training for young faculty in the UK system. It is worth noting that the majority of new hires in recent years come from researchers trained outside the UK, and in most cases completely unfamiliar with its system. In particular this means that in addition to teaching training an effort has to be made in topics such as: the UK A-Level system, and the background of the students in general, the UK undergraduate system in general. (i.e. structure,*

grade system,...), structure of the degree in the specific institution, tutorial sessions... These topics can be covered by means of some short notes, or in an induction meeting for new faculty. Since it is common in many departments to assign a mentor or supervisor to new junior hires, these should be topics of discussion during regular meetings'

- *'I thought carefully about your email and about my initial experience in Warwick. Before coming to England I had some experience dealing with students as a teaching assistant in Switzerland; more importantly, I taught for seven years in the US in three different universities. The range of my teaching was rather wide and included basic math courses (calculus, probability for engineers, etc...), as well as courses for graduate students. The organization of English universities, and the English students, are quite different from both Continental Europe and the US. I needed to adapt in many respects. I was grateful to several colleagues for many pieces of advice. What has struck me so far as the biggest difference to my lecturing experience in the US is that less of the decision-making is left to the lecturer, at least when it comes to first- and second-year courses. Rather, most decisions seem to be committee-based; this was most striking when it came to deciding on the final course marks. In retrospect, I have to say that I am satisfied with the outcome of my first year of teaching in UK Higher Education, and convinced that the knowledge I now have will leave me better prepared for the future classes I will be teaching here. Looking back at the training I received, though, I would have appreciated an introductory module on how the British course system typically works and in particular on how the various levels of bureaucracy are organised'*
- *'As a new staff member (and foreign national) I would have found the following useful:*
 1. *Discussion of the terminology of UK academic qualifications (A levels etc).*
 2. *Training in how to write British-style exams - specifically, guidance on how time-consuming this can be.*
 3. *Some training in personal tutoring, and discussion of how tutorials can complement supervisions etc.*

4. *Discussion of what students do, can, and should not expect, with regard to lectures, lecture notes etc.*
- *I got my training as a teacher in the USA. There I attended a proper “teacher training”- course, and later even participated in teaching one. It was very helpful. The lessons I learned can be briefly summarized as follows:*
 1. *Handling the blackboard correctly is extremely important. A short training would be useful: e.g., to give a new lecturer a simple example and ask them to work it out on the board. Teaching various small tricks, e.g., use of coloured chalk, etc.*
 2. *Being taught how to explain thing – for example breaking an explanation into relatively simple steps.*
 3. *Standing and moving in front of the class can be a bit tricky. Videotaping a person and then discussing it with them can be very very helpful.*
 4. *Speaking at a “proper volume” is a good thing.*
 5. *Keep eye contact with the audience.*

These probably are the basic things that should be explained to a starting teacher’

Local information

We encountered an unsettling number of comments relating to lack of information provided to new staff about the way the department and university work, especially to the extent that this affects the new lecturer. There seems to be room for the development of some sort of departmental induction pack, and perhaps the MSOR Network could produce some sort of template for this. Our respondents provide a few ideas.

- *‘graduate studies – again quite different from many other countries - specifics of how things work in the department’*
- *‘The departmental series on the other hand did provide a good introduction to the specifics of Lancaster University and the Department of Mathematics and Statistics in particular but failed to address all of my initial concerns’*

- *‘Give facts early. Hold an orientation several days before classes start (so new lecturers have time to make webpages etc before classes start but after the orientation). Focus on information that differs from institution to institution (if the person running the orientation is not relatively new, they should ask recent hires what this is!). For example, the most important information at Warwick just before classes start is that a 9-10 class actually runs 9:05-9:55, followed by the fact that there are no classes the first Monday but your tutees will look for you at specified times (that you have no control over). Other examples would be local conventions for how many assignments are normal for different levels of modules. Also give facts at any other critical time (such as the end of the year). Again, just the facts is most useful. This includes details such as rules about emailing marks, and when to expect students to ask about marks, and what advice they need to be given in each case’*

Running tutorials

Often these are the first duties assigned to a new lecturer, and it may be before they have had any training. And even if they have had generic training in the ISD, this is often nothing like the sort of activity and skills required in a busy maths tutorial. So to the new lecturer this can be quite a stressful activity, and there is evidence that many departments under-estimate this. Also, since it is so front-line so far as the students are concerned there is unfortunately a lot of room for false impressions to develop, often to the detriment of the new staff member. For example a new lecturer may be incorrectly perceived as unhelpful if they refuse to discuss a problem that is to be assessed as coursework, whereas an experienced staff member will know how to help the student without giving the game away. Ideally new staff should share their first tutorials with experienced staff.

- *‘The hardest (from the point of view of doing my job well) thing I found was interacting with students on a smaller scale: running tutorials, supervising and marking longer pieces of coursework. For me, this was always using other people’s material, and helping students with other lecturer’s problem sets. I felt that I could control very little, and that often I did little more than give out answers with explanations which perhaps made little sense to the students. I had complaints about my marking (of coursework) and it was very hard to know if I was being*

harsher than my colleagues: I got no feedback except from students. Inevitably, any training to address these matters would probably vary from university to university'

- *'Your email is about which topics would be best taught in a training course. The truth is that I can only envision a limited role to training courses. One, maybe two hours dealing with tutoring would be useful'*
- *'Dealing with tutees is a bit peculiar, and nothing really prepared me for that. A meeting with basic information would be useful indeed (I might well have attended some, I cannot remember). It could actually help to suggest a complete organization of tutoring:*

1. *how to schedule the tutorials;*
2. *what to do then;*
3. *what to do when students do not show up.*
4. *Also, for second year students, how do deal with the second year essay.*

Of course, tutors are given great latitude to organize things as they wish. But it would help to have a very concrete possible plan'

Teaching large classes

Another baptism of fire to which new lecturers are sometimes subjected is the large class. The skills of eliciting interaction and student participation in large lectures are particularly sophisticated and take years to develop. It is all too easy for the new lecturer to take the fall-back position of not engaging with the students but simply deliver, literally, a lecture with little or no student interaction. This can then become a habit that becomes hard to break. New staff should not really be given large classes as their first teaching duties, but should cut their teeth on more manageable groups of students, while perhaps attending some large classes run by good experienced teachers.

- *'Training in teaching large (100+) classes: in particular how to control a large class, how to judge the pace and level of exposition required in a lecture, how to make large class teaching more interactive and less passive than a standard lecture'*

- *‘More detailed training on large group teaching, specifically in maths and the sciences, would have been extremely useful to me’*
- *‘Opportunity to talk about how to handle large classes (my very first teaching assignment was to teach a class of 150!) with people at the MSOR induction event’*
- *‘I have never had a problem with giving seminar-style research talks: “be prepared” seems to be a good motto. When lecturing small groups of students, this experience seemed to translate well, but I still find lecturing to large groups to be (irrationally) terrifying. I think experience will help, but one side-effect is that I am very hesitant to give anything but a standard style of chalk-and-talk lecture, at least until I am comfortable with crowd control, and so forth. Much of the training I had seemed to assume that the basics of lecturing were easy, or so similar to seminars, that little needed to said. I am hesitant to try more “experimental” methods of lecturing, which was exactly what all my training concentrated on’*

Presentation media

It used to be simple - get a box of chalk from Maureen, and hope nobody has nicked the board duster. Not any more. This is one area in which new staff often have the upper hand on their established colleagues, having been brought up on the latest high tech gizmos. The trouble is, Luddite though it might seem, they would probably be better off with the chalk (or pen), and certainly their students would. We continually tell our students that maths is a doing subject, so it is and that’s what we should spend most of the lecture doing, working through problems on the board, rather than clicking up the next pristine Powerpoint slide, and waving a light stick over it.

- *‘How to better integrate external information such as material in text books into the course. How do I get the students to do more background reading to the material presented in lectures?’*
- *‘How to use electronic presentations more effectively? Out of 36 lectures I only did 4 lectures (a section on statistics) with a presentation made with latex, but I went too fast, and ended the lectures 15 minutes too early’*

- *‘I would also have liked to have received more specific training on the use of computer resources in teaching mathematics - I run computer practicals as part of one of my courses, but I only received very general training on “practical-based teaching”’*

What incoming students know

Even for UK lecturers who have been through the UK system and are familiar with A-levels and their content, it is not always clear what the students actually know and can do. For second and higher year students things are not quite so bad, because lecturers who taught them in previous years will be able to give some idea of the class’s background. For first year students we do not have this history and even for experienced staff it can be difficult to get a clear picture of what can be relied upon. Checking out past A-level papers and syllabi can help, but it has to be remembered that in general the student will have been able to achieve a reasonable mark from good coverage of a relatively small proportion of the syllabus. And they may have been able to get away with quite a shallow treatment of most of it, and may well have forgotten a lot of it already. Certainly, their facility and fluency level will probably be fairly low, and it is that which dictates the overall pace of delivery. So new staff need a great deal of help in this area, preferably from the most experienced staff.

- *‘I did my A levels a long time ago so I would also benefit from knowing exactly what students are taught in School mathematics now’*
- *‘Quick introductions to the general “mathematical standard” – my initial class was too difficult by British standards’*
- *‘the secondary school exam system, and the mathematical content of GCSE and A-levels what topics are students expected to know how much will they realistically remember’*
- *‘Student expectations - it is a long time since we started at university. What do students expect these days of their lecturers?’*

Mentoring and teaching observations

Most new staff welcome advice from an experienced member of staff who sits in on their lectures, and we devote large sections of this book to this area.

For now we emphasize the delicacy of the task. We need our best, most experienced and most empathetic and socially skilled staff as mentors. There is no room whatsoever for any connotations of managerial input. Unless they can demonstrate the required skills and objectivity the very last person who should be mentoring or observing is the lecturer's 'line manager'.

- *'So I would have benefited from less generic training (Certificate in Academic Practice) and more discussion with good mathematics teachers (this could be called mentoring but it is not necessary to be so formal)'*
- *'Peer observation of teaching'*
- *'For me, the most valuable part of my training occurred 6-12 months after I began teaching and revolved around opportunities for informal discussion with peers and more experienced staff, often after they had observed my teaching'*
- *'It is crucial that the trainee receive feedback through a peer review process, conducted by an experienced lecturer. In my experience these sessions can be extremely useful in identifying aspects of the teaching that can be improved on. Since teaching very much depends on the personality on the lecturer, it is in this review session where more specific and useful information can be provided on topics such as: blackboard use; quality and size of handwriting; audibility of the lecturer; structure of lecture / defined goals for the lectures...'*
- *'"Peer observation" was extremely helpful to me personally when I came to Warwick. That was the first time I had taught a class of 300 students, and I was feeling rather insecure and unsure of myself.'*

Project supervision

Only one or two respondents mentioned this, but since project supervision is difficult for even experienced staff it is worth giving some thought to how new staff might be supported in this area.

- *'Supervising students' research projects - what is the point of such projects? How to help students get the most from the experience? How to avoid or deal with problems that can arise'*

Lecturing to mixed ability groups

This is a headache for most of us, and a major worry for new staff. Ideally of course a new lecturer should not be assigned such a problematical class, but they will come up against the issue sooner or later. Sympathetic and intensive training for this is needed, and it would be useful if the lecturer had the opportunity of watching a couple of such classes being taken by experienced staff before they grasped the nettle themselves.

- *‘How to lecture to groups with mixed ability. For first year courses it seemed common to have people who are still having problems with basic algebra as well people with A grades in further maths. Ideas like flagging some problems as harder are a possibility’*

Using your voice

This is one issue that can be safely left to the generic ISD, who usually provide courses or workshops in the area. However, it is worth noting, particularly in the case of foreign lecturers, that diction in mathematics is more important than in most subjects, because one is often running through complicated concepts and equations with a wide range of symbols. In such case loud clear speech is essential - and if microphones are in standard use then the new lecturer will also need to know how (and **if!**) these work.

- *‘From my own point of view, most of the more useful training that I have received has dealt with “practical” issues, for example we had an excellent session on voice projection’*

Curriculum design

It is not unusual for departments to provide a set of notes for a course given to a new lecturer, prepared by the previous lecturer. Of course such things can be useful as a guide to the sorts of things considered in the course, but on no account should they be used verbatim by the new lecturer. A lecturer who cannot put in the time to prepare their own notes and materials is in no position to teach the subject, and such laziness should be discouraged. It makes for very inferior teaching. On the other hand the design of a new module, or even a lecture, is a difficult and technical task through which new staff should be supported.

- *‘How to change a course in a safe way. New lecturers are under pressure to stop the students complaining on staff student committees and questionnaires. Feedback is good of course, but I would be nervous about making a big change in the teaching style of a course in case the final exam mark went down by a large amount. It is not always clear whether a new way of teaching will improve students’ understanding. I felt happier changing a small section of the course’*
- *‘It can be hard to grasp the issues involved until you have started to teach. For this reason, I think training at the outset should focus on departmental norms and expectations. After some experience has been gained, discussions on different approaches to learning and teaching are more meaningful, and observation of others’ teaching becomes invaluable’*
- *‘Before starting to teach, it would have been helpful to talk through the process of organising a module - from the syllabus, to writing and marking the examination. This would have included: the usual structure of lectures, classes and tutorials (how many, how long? etc.), setting and marking problem sheets (how often, how many?), writing exams (the role of the internal and external examiner, marking, scaling), a time line of the academic year (when do exams need to be written, syllabus changes suggested ? etc.). The mechanics of other aspects of teaching, such as personal tutoring and project supervision, should also be included where relevant to the teaching role’*
- *‘So, when I started teaching, I had inherited the course notes, which I actually did not like – too many words, not enough proofs and examples’*
- *‘Designing lectures - different styles that can be adopted. Advantages and disadvantages of providing written lecture notes’*

Personal tutoring

This is an area where a good ISD can provide a great deal of support and training. A large number of the issues are entirely generic, and discussing them with a wide a range of different staff across the university can be very beneficial. And often it requires good knowledge of university wide facilities and resources, with which the ISD is more likely to be familiar. On the

other hand it also requires good knowledge of the students and how they relate to the department and for this it is the department that will have the appropriate experience and expertise.

- *‘Personal tutoring - what are the duties of a personal tutor? What are common problems brought to personal tutors? How to handle them’*

Board technique

Perhaps surprisingly, many authors omit this topic, which is particularly important in mathematics. Fortunately Krantz ([17], pages 39-41) emphasizes it in some detail. It is of course something that will be picked up in teaching observations. One important thing to impress upon new staff is that presenting a lecture to undergraduate students is **not** the same as presenting a paper at a seminar or conference. Although the ostensible subject matter may be simple in comparison, as an exercise in communication it is far more sophisticated.

- *‘One has to be explained that handling the ‘boardwork’ correctly is extremely important. (Maybe a short training in that would be useful: e.g., to give a person a simple example and ask them to work it out on the board. Teaching a person various small tricks, e.g. use of coloured chalk, etc.)’*

How to explain things

Again, since this is the very essence of teaching, it is surprising that it is only mentioned by one person. Actually one of the chief difficulties that new staff have is finding ways to explain things to people with a far less developed background than themselves, when up to now in their career their explanations have only had to satisfy those more experienced than themselves. Some foreign lecturers report that, in their own country, if a student does not understand your explanation that is their fault not yours. In the UK the attitude is generally different. On any given topic there are good explanations and there are bad. A good teacher knows the difference. This is one area where generic training within a good ISD can help - encouraging delegates to explain their subject to delegates in other disciplines, who may require even more sympathetic treatment than undergraduate maths students.

- *'... being taught how to explain things (e.g. breaking an explanation into relatively simple steps, etc.)'*

Time management

These days even experienced staff may feel in need of some time management training! Both of the authors will admit to sometimes floundering under the current pressures we face, from administration, increased student numbers to publication and grant deadlines. Imagine what it must be like for the new lecturer, who as yet doesn't know which deadlines can be safely ignored and which are crucial, or how much time it is sensible to spend helping students. Their mentor can play an important role here, helping them to navigate their way through administrative jungles and conflicting priorities. They can guide them to the best people to oil the wheels and so on. One thing is pretty certain - an afternoon's ISD session on time management will almost certainly be a waste of time!

- *'Time management - if, until now, you have been doing only research, suddenly you may be faced with a larger number and wider range of tasks to perform. So, it might be useful to learn some time-management techniques'*
- *'The reality of teaching my first class here in Britain turned out to be much less clean-cut than it had appeared when parcelled out into neat modules. I struggled to keep up with the sheer amount of information that needed to be processed in the run-up to the term. Apart from dealing with the day-to-day management of my class, I had to make sure to respond to the often time-sensitive requests from the various layers of bureaucracy involved in the course organisation. That being said, I received a lot of advice and support from the more experienced colleagues in my School, who saved me from committing any serious blunders'*

Miscellaneous

The list above is by no means exhaustive, and below our respondents voice some further issues, and no doubt if we widened our survey we would find a lot more issues. Perhaps the extracts in this section best serve to give voice

to the many and varied issues facing new staff in just their teaching duties. This is partly why we advocate in-house departmental training - it is simply unrealistic to imagine that a few visits to ISD workshops and production of a portfolio can do more than scratch the surface in the real academic world.

- *‘Having to jump through the hoop of passing “Teaching and Learning” courses (by writing essays, of all things!). These seem to have become an end in themselves and seem to be in severe need of pruning. (Talking to colleagues in other universities I know that this is not unique to my university.)’*
- *‘The hour in which I learnt most about local teaching and learning culture at Warwick was at an evening event where a cross-section of undergraduate students came and asked and answered questions about what they and we liked/didn’t like/expected about the learning experience. Highly recommended!’*
- *‘Opportunity to attend a second MSOR workshop for those with about 2 years experience to better reflect on, exchange and learn from experiences’*
- *‘Over next year, I was quite lucky to find information about MSOR Induction Course for lecturers new to teaching mathematics and statistics in UK HE. It was incredible to talk to other new staff and discover that they had similar problems although working at different institutions! And what a relief was to hear one of lecturers talking about the role of own course notes, and what a disaster is to follow the course someone else wrote! During second year of teaching, I wrote my course notes, put lectures on Power Point slides and feedback form on the module web page. I was really satisfied with how teaching went on. My only regret is that MSOR runs introduction course only once a year and I had no luck to attend it before my teaching responsibilities had started’*
- *‘It is important that the training isn’t felt as an imposition, because of a heavy load of compulsory activities. That might end up having a counter-productive effect’*
- *‘As far as teaching is concerned, I found it very useful to get information about similar courses taught in Warwick, as well as past exams. I am also a strong advocate of teaching evaluations, that help detect and*

correct many problems. I attended a few meetings and training sessions about funding opportunities, which I found extremely useful. They were run either by the university or by EPSRC.'

2.8 Training that meets lecturers' needs

The previous sections summarize a wide range of inputs to teacher training, from the national to the chalk-face level. We think it reflects accurately the current situation. In the rest of this book we use the insights provided to argue for strategies and methodologies that we believe better meet lecturers' needs than current provision. While there is a need for three different providers of training, academic departments, ISDs, and the MSOR network, we believe the principal locus of training should be in academic departments, and that it is the responsibility of departments to recognise this. Indeed, as the evidence of the last three sections and Sections 2.5 and 2.7 shows, despite the efforts of the ISDs, most *effective* training already takes place within departments, in the form of informal discussion and mentoring. We believe it would be wise for departments to recognise this and promote it, as a counter to the widely publicised misapprehension that academics "receive no training in teaching", and as a means of providing their new members with the essential maths-based training that generic training cannot provide. As far as is possible without sacrificing the flexible and consensual nature of this informal training, it should be counted as part of the formal training that new lecturers receive.

Teaching is one of those activities that is only perfected through practice. Although not many would dispute this, actually justifying it requires some reflection. Teaching is something we have all experienced, at school, at university and at home, for thousands of hours, before we come to practise it. It is such a fundamental and essential part of every human experience that we all begin our teaching careers with a huge body of information, understanding, and prejudice about teaching. All, or almost all of this will be present at an intuitive, un-axiomatised level. So what is the best way to approach beginning practitioners who have already seen so much and formed strong views about how to teach? The ultimate purpose of training is to give us the means of improving our teaching in practice. So any underpinning theory has to be aimed at practical performance and enhance its effectiveness. This requires filtering and organization of relevant outcomes of education theory

so as to be practical to use. Like many people skills - parenting, managing, and so on - teaching is only mastered through long apprenticeship actually on the job. But this is not an argument for no initial training before entering the classroom. It is perfectly possible to recognise a great many characteristics of a teacher without seeing them in the classroom, and there are many ways of piloting their skills without blighting the lives of their students (for example a mini-lecture to a few peers). It is a simple matter to instil broad appreciation of the foundations of education theory and practice before the lecturer is ready to go into the classroom, with support, and begin their professional development. Of course, this does not have to be generic training.

Coupled with the richness of each of our experiences of teaching is its variability. Academics begin to teach with a huge range of different styles, unconscious theories, and levels of competence and insight. To attempt to address them as a group, at a theoretical level, on any aspect of teaching at all, is to run the almost certain risk of saying what is obvious to one section of our audience or incomprehensible to another.

Why is any of this an argument for the value of learning on the job? Precisely because learning on the job (and being taught, and critiqued, on the job) allows the beginning lecturer and their trainer to discover and respond to the individual and highly variable level of knowledge, skill and achievement that each of us brings to our teaching. It is this highly individual, one-on-one instruction, coupled with the sharing of experience in a community of practice, that is likely to be bring real progress.

We can have little idea what a beginning teacher needs to work on until we see him or her teach, or at least do some simulated teaching. So we see the primary location for a new lecturer to progress in as being his or her classroom, and in the common room or the office in a debriefing and discussion after a lecture. This is certainly what we learn from the previous sections. Above all it is the advice and support of colleagues that enable the new lecturer to learn their profession. On the other hand we have to think of the students. It will come as little comfort to students to know that the perhaps poor teaching they have had from a new lecturer has been useful in the lecturer' development.

Three kinds of input are useful in helping a new lecturer develop.

2.8.1 Departmentally based training

The first is from someone who understands the material the lecturer is trying to get across, and can comment on its accuracy, its organisation, and its appropriateness to the audience. *Such a person must necessarily be a mathematician, and to the extent that site-specific issues are at stake, should ideally be a colleague from the new lecturer's department.* Departmental mentors should play a fundamental role in the training of new staff. Of course, this is contingent upon the mentors having the skills the department wants its new members to acquire. If this is not the case, some other approach will be needed. Such might be the situation of a new mathematics department, or a department undertaking, for the first time, to teach a new group of students. But we expect that the majority of departments will be home to most of the skills they would like their new staff to acquire, and describe in the pages that follow a number of activities that help departments to make them available to new lecturers. However, one of the principal resources that can drive a training programme is the energy and commitment of new staff themselves, who in the majority enjoy teaching and can see its value and importance. We have to create a situation in which this enthusiasm can be channelled into effective learning.

At this point we mention a theme that will recur in the rest of this book. This is the effect on the department of the introduction of a departmentally-based component to staff training. This will become clear as we discuss some of the activities in detail later on, but the key point is to open up activities that are nominally part of the training to other members of the department - "old" staff with an interest in teaching (all of them, we hope!), undergraduates, graduate students who are probably engaged in some kind of teaching or supervision of undergraduates in any case, and have a natural interest in teaching because of its likely role in their future career. The existence of a training programme inside the department can help to energise departmental interest in teaching, and thus benefit a wider group than the small number of trainees it is nominally intended for.

One further argument in favour of a departmentally based component to the training programme is that far more than a central, generic programme, it can seek and respond to the needs and interests of the new staff undergoing the training, and of the department they belong to. Being local, it can evolve in response to local needs.

2.8.2 Generic skills

A factor complicating training as a teacher is the proximity of teaching skills to other relationship skills that we very rarely receive any instruction on, that are indeed rather intimate and personal. We might be willing to receive guidance on the way we speak to strangers or discipline our children, but only if we have a great deal of respect for the person offering it. There is a significant potential role for ISDs as purveyors of the sorts of 'people skills' of value in teaching, though they do not come across easily through formal instruction. However, they do make up a significant segment of what are known as generic skills, and which might be developed by a central ISD rather than within departments. Among the generic skills are

- skill in engaging and empathy with students
- skill in assessing the learning needs of students and designing modules and teaching strategies to meet these needs
- skill in delivering prompt and effective feedback which takes account of personal issues
- skill in assessing the success of one's teaching

Every teacher must possess these skills. Many teachers can benefit from generic presentations of such skills in the company of lecturers from other disciplines. Precisely because they are generic and fairly easily appreciated and assimilated, and particularly if they are presented in a laboured and patronising way, staff from many disciplines (not just mathematicians) often regard them as obvious, anodyne, and having little real content. The same may be said of the axioms of an algebraic field, which have been known implicitly for centuries. They are all 'obvious' to most A-level students, and of course are generic in the sense that they apply to lots of different examples of fields. But this does not detract from their critical importance and utility. They make plain important similarities between disparate objects.

We all believe we understand the importance of effective feedback, but may have only experienced a rather narrow range of different kinds of feedback, and of the degree to which it can succeed or fail. A well-delivered generic course can open our eyes to possibilities we have not imagined. If the generic ISD provider understands the need for examples and contextualisation, and moves things along with speed, stimulating participants, whether

they be mathematicians or historians, to invent and exchange their own examples then they will be doing a good job. Unfortunately, this is a very challenging role, and few succeed in it. Many instead resort to vacuous platitudes. After all, because of the way that the requirement to train new staff was rather suddenly imposed by central government and university hierarchies, many ISDs have had little opportunity to develop expertise in this role.

So there is much to be said for properly delivered and empathetic generic training, provided by a centralised ISD. But it is clear that the training cannot ignore the contextual demands of chalk-face teaching.

2.8.3 The MSOR Subject Centre

The Higher Education Academy supports a network of Subject Centres, whose aim is to provide the subject-specific content missing from generic training courses. The Mathematics, Statistics and Operations Research (MSOR) Subject Centre, based in the University of Birmingham Mathematics Department, with branches in the University of Glasgow and at Portsmouth University, runs courses and induction sessions both in Birmingham and in requesting institutions. It has a staff of ten academics and five administrators, and has key contacts in all HE Mathematics departments. Its brief is to provide expertise and collegial support and networking across the whole MSOR community. It acts as a bridge between the Mathematics Education community, and university mathematics staff – it has run a number of one-day conferences bringing together mathematicians and mathematics educationalists⁵. Through its induction courses and workshops, it provides specialised training, and opportunities for new lecturers to meet and discuss with their peers. Among its main activities is the *Induction Course for New Lecturers*, held in mid-September each year at the University of Birmingham. This takes place over two days partly to provide an opportunity for social time in the evening. The schedule of the 2009 event is still available at www.mathstore.ac.uk/workshops/induction2009/index.html.

Some university staff training programmes count attendance at the MSOR Induction Days towards completion of their training programme, but as yet they are a small minority. This highlights one of the problems of the current situation: in the absence of departmental involvement, there is no straight-

⁵See the website [26].

forward mechanism by which the Subject Centres can deliver their resources and expertise. Relations between Subject Centres and ISDs are not always easy. ISDs see themselves as primary providers of training, and are often unwilling to relinquish the status and funding that this gives them. Instead of drawing on the resources of the Subject Centres, they sometimes see them as rivals. Since different Subject Centres offer different levels of provision with different degrees of success, including this provision into university staff training programmes, and counting it appropriately, can become an administrative headache to ISDs. This is borne out by the results of the LMS survey, and by the experience of the MSOR Subject Centre. Here again, a departmental component to staff training can begin to resolve the problem. A departmental staff development coordinator can become the conduit through which the resources of the Subject Centres can become available to his or her department, or, indeed, to the ISD. We strongly urge anyone beginning, or considering beginning, a departmentally based component to staff training, to attend the MSOR Induction Days in September. They are well run, thought-provoking, enjoyable and not excessively demanding. You will learn what other people think about the issues we are discussing here.

2.8.4 A Training Triangle

In this section we have given three main areas from which a new lecturer might receive training: On the job practical departmental training, generic ISD training with new staff in other subject areas, and the MSOR Network providing induction in the principles and practice of teaching Mathematics in HE from a UK Mathematics community perspective. In their individual ways each of these fulfils a valuable service in supporting new staff and together they comprise a tripartite partnership that should meet the needs of new staff teaching mathematics in the UK.

Chapter 3

The infrastructure for departmental training

3.1 An overall strategy

The most difficult aspect of discussing any sort of training regime for Mathematics staff in UK universities is the wide and sometimes weird diversity of provision and organisation across the HE sector. Of course, the authors cannot help but speak in terms that they recognise from their own departments, but on the other hand we are well aware of the different terminologies and cultures used elsewhere.

However, whatever the colour of their coat, every department/school/subject group will need some sort of organisational structure in which to embed their training. And many aspects of such a structure will be common across the sector. We believe they will be based on similar principles, which we summarise in the next section, and will contain common key components such as pragmatism, a coordinated programme of activities, liaison with the central ISD, realistic demands on the time of the new lecturer and the department, clear, locally defined objectives, opportunities for open debate and personal development, needs analysis of the lecturer, and some form of ‘assessment’ or quality oversight of the training programme to ensure the objectives have been met. In this chapter we will say something about all of these, never intending to push a particular view, but always hopeful that something we say may strike a chord and set the reader off on a train of thought that might be fruitful for them.

3.2 Principles of training

Let us frame four principles ¹ that we believe to be essential in the in-service training of new staff: training should be

1. *Student-centred: it should contribute as directly as possible to enhancing the departmental provision for students.*
2. *Embedded: as far as possible the activities should be closely linked to the normal run of activities undertaken by a beginning lecturer.*
3. *Transparent: the process of training and the evaluation of participants' progress should be clearly visible to the university's ISD, or, for example, to the HEA.*
4. *Self-sustaining: once in place, the programme must run itself, with a robust administrative system that is not a heavy burden to any academic in the department.*

Most departments have enough real problems associated with teaching and learning. There is no reason to squander the efforts and intellect a new member of staff on artificial exercises for their (possible) benefit only. If they write a reflective essay, then ensure that this reflection serves the purposes of teaching. If they do a project, then make it one related to specific teaching issues in the department. If they have to assemble resources, make sure they will be available to the department. These principles are not merely making a virtue out of a necessity (though this is no bad thing). If the training is divorced from the realities of teaching, it will be viewed with disdain by all staff, new or established. If it can be seen to contribute to departmental practice, then teaching and training will enrich one another.

3.3 Practicalities

One of the problems with writing this book is that we are conscious that 'department' covers an immense range of provisions. Some maths departments are very large with many areas of interest and regular staff turnover of half a dozen staff a year, with visiting staff adding input and expertise.

¹These were originally formulated by Trevor Hawkes in his documentation for the Mathematics version of the Warwick Teaching Certificate.

Other ‘departments’ may consist of a few mathematicians perhaps located in some umbrella department, who can’t remember the last time they had a new member of staff. To the latter the term ‘department’ seems somewhat generous, and much of what we say will ring rather hollow. To avoid tiresome re-iterations of expressions like ‘If you have a large department you can ...’, ‘If you don’t have many staff then you could ...’ we will imagine our department to be large, well resourced and with a healthy regular staff turnover, for which anything is possible. So we suggest a wide range of possibilities for the department. Then less well endowed departments can cherry pick ideas according to their own resources. In any case, no one’s resources are limitless so where appropriate we will suggest efficiencies that can be made in the provision.

3.4 Coordination of training activities

A department wishing to run its own staff training should appoint an experienced staff member, who we will refer to as the Coordinator, to oversee it.

The Coordinator should have a strong commitment to teaching and a good knowledge of the department’s teaching activities. Anyone taking on this role should be prepared to fulfil it for several years; once the programme is in place, the task becomes a lot easier, but continuity is an important requirement. It is a demanding role: over the first two years it probably needs as much time as being, say, (departmental) Senior Tutor or Director of Undergraduate Studies. On the other hand, besides the contribution it can make to teaching, a departmental training programme should save new staff many hours unprofitably spent on generic activities. Moreover it is a role in which it is possible to contribute to the experience of new staff, and, directly and indirectly, to the department’s teaching, so it can bring a great deal of satisfaction.

The resources a department can devote to training their new staff depends on the annual turnover of staff. If one has a regular turnover of a few staff a year, then it will be worth setting up a durable infrastructure to deal with their training needs. If there is just one new appointment every few years then the role of overseeing the necessary training might be adequately filled by the mentor(s) for that appointee, although there should still be some durable framework that ensures any lessons learned and experience gained

are passed on for future years. In fact, with the increasing importance of teaching it will probably now be sensible for any reasonably sized department to have a staff development coordinator concerned with teaching and learning for all staff.

The training infrastructure within the department and those engaged in providing it, should be adequately recognised and resourced. The Coordinator will certainly need secretarial support.

As we have said, one of the first things the Coordinator should do is to attend the MSOR Induction Course held in Birmingham in mid-September. Apart from its immediate benefits, described above, it will help to demonstrate a serious commitment to staff training in the eyes of the ISD and the university hierarchy. Since deciding to take control of staff training is potentially contentious, as we describe in the next section, this can be politically valuable.

3.5 Relations with the university's ISD

It is likely that the Coordinator's first task will be to negotiate with the ISD or other university authorities for the introduction of a departmentally-based component to the training scheme. The initiation of a training programme like the one described here may be seen, with some justification, as an implicit criticism of the training the ISD is delivering, and this can easily lead to suspicion and ill-feeling. Negotiating this source of conflict may require strong resolve and the active support of the Head of Department. It is important to make clear that the aim is to provide better and more appropriate training, and not to enable new staff to avoid training. Academics are often perceived as arrogant and uninterested in teaching, especially by some CPD professionals, again with some justification. Pleasurable though open conflict may be, it is in the end necessary to satisfy the ISD that your training programme will deliver, partly because it is almost certain that it is through them that any provision or qualification you offer will be endorsed. Ultimately all university Teaching Certificates seek to conform to the national Professional Standards Framework set by the Higher Education Academy (see Section 2.1), and it is preferable to have a central university body such as the ISD mediate between departments and the HEA than for each individual department to negotiate directly with the HEA - unless, that is, the ISD is so inflexible that it resists all attempts to bring in some component of departmental provision.

To convince the ISD to allow a departmental component in the training, the Coordinator will have to present a clear programme for that component. At the simplest level, the department could propose to replace some of the generic workshops with its own. If their aims and structure are coherently and clearly set out, the ISD should have no reason to object to their incorporation into the training programme. Representatives from the ISD can be invited along to witness or participate in the departmental workshops. Since there is a great deal that can be usefully conveyed to mathematicians through such workshops - that is, they run little risk of being devoid of content - the ISD's representative should be impressed and won over.² A mathematics department with patience and resolve may be able to develop a departmentally-based programme incrementally.

In the surveys we have conducted and experiences across the sector we have encountered a wide range of practices in links between ISDs and maths departments. On the one hand we have seen highly cooperative joint ventures with mutually agreed divisions of work and responsibility and good levels of liaison and mutual respect. Discipline-based activities such as the MSOR Network Induction Course are given credit as part of the provision. Mentors are appointed within departments and are trained for the role. On the other hand we have come across situations where ISDs jealously guard what they see as their turf, don't recognize any role for discipline-based provision, won't accredit external activities and have perfunctory relations with the departments. The latter end of the spectrum is of course indefensible. Our only advice here is for HODs to lobby vigorously for changes - in the best interests of their staff and the students they teach.

It is worth mentioning that at Warwick, in the midst of a heated polemic inside the department about the inadequacies of staff training, in which the department's leaders insisted that we had no choice but to accept the generic training, we expected resistance from the ISD to our proposal to run the training ourselves, and were then surprised by the openness of the ISD to the idea.

If the department wants to take on the role of principal provider of the training, then it has correspondingly to make much more detailed plans. At Warwick, where the generic programme was quite seriously resented by new

²In Chapter 5 below, we list a range of suitable topics, with suggestions on resources and structure. Some we have run at Warwick, and we comment on their successes and failures.

staff, the decision was taken to plan the complete programme in some detail, and Trevor Hawkes, a senior member of the Mathematics Institute, was seconded for a year to the ISD, with the preparation of a suitable departmentally based programme among his responsibilities.

The Coordinator must take into account the other training inputs from outside the department, and weave these in with the department's training. It is important to find out what the ISD is able to offer. In general, it seems that workshops with generic titles like "Teaching Large Classes" or "Running Seminars", intended for new staff from all departments of the university, are of little or no value to mathematicians (we do not speculate on their usefulness to others). But the ISD may be home to valuable expertise in areas of professional development such as running teaching observations, training mentors, use of the voice, and counselling skills for tutors, and this expertise should be harnessed wherever possible.

The Coordinator should be sufficiently familiar both with the ISD's resources and expertise, and with each new lecturer's training needs, to be able to advise new lecturers on which of the ISD's activities they should participate in.

The Coordinator has to maintain a delicate balance between the ISD and staff in his or her department. If it is the ISD which accredits the training programme, they have to be satisfied that it meets their demands. Many academic staff find some of these demands excessive, and feel angry and hostile towards the ISD's generic programme. The Coordinator has to convince staff that the departmental programme will save time currently spent on useless generic training, and that the time they are asked to contribute as module mentors (see Subsection 4.1 below) will be well spent. Their goodwill and cooperation are essential. Provided the departmentally-based programme is clearly understood to be different from the generic programme, the hostility staff feel towards the latter can become goodwill towards the former. However since the requirement for transparency (Principle 3 in Section 3.2 below) sometimes clashes with embeddedness (Principal 2), this goodwill can be tested. The Coordinator needs to have a light touch and a willing preference for the possible over the ideal in order to avoid losing staff goodwill or the acquiescence of the ISD. Staff who contribute to the training of new staff to any significant degree, such as mentors, should ideally have their efforts recognised in some way, perhaps by reduced load in other areas, such as fewer personal tuttees. There is no need to be over zealous in this, the main objective perhaps being to emphasize to all staff that such work is valued.

3.6 How long is the training?

In most universities, the completion of training is marked by the award of an institutional Postgraduate Teaching Certificate, or membership of the Higher Education Academy. The term ‘Postgraduate Certificate’ has a precise meaning in UK higher education: it consists of 60 CATS at Master’s level, with each CAT itself having an expected time commitment of 10 hours. New staff are therefore nominally expected to spend 600 hours on their training. Taken literally, this seems rather daunting: twenty hours per week over a thirty-week academic year, if it is to be completed in one year. Even half of that seems like an extraordinary commitment from staff who are already expected to teach and carry out administrative duties, and whose overriding concern may very well be their research. The total only becomes reasonable if a significant contribution is made by the time spent teaching and preparing to teach. These activities are the focus of in-service training, and must be recognised as an integral part of it. It may be worth spelling out the sort of time a new member of staff is expected to devote to various aspects of their training, as a guideline to help them manage their first years in the job. An example is shown below, but of course it will not be suitable for every new staff member and would need to be negotiated with them.

Activity	Hours
Preparing lectures	100
Delivering lectures and tutorials	80
Discussions with mentors	20
Preparing exams	40
Marking	40
Attending and reflecting on workshops	60
Essays (including preparatory reading)	80
Project	80
Research supervision	25
Other	75
Total	600

“Other” might include research-related training, e.g. in writing grant proposals and managing grants, or in administration. Some universities now include such components in their centrally delivered staff training programme, and any departmentally based programme should reflect that.

3.7 Learning Outcomes

What do we want of our training? At a minimum, we want the new lecturer to meet the demands that the university and the department place on their existing lecturers. For this to be possible, it is a good idea to make these demands explicit. This might seem like a Herculean enterprise - both the defeat of the Hydra and the cleaning of the Augean stables come to mind. In fact, we believe it is possible to write down a list of requirements that is reasonably complete without being unreasonably long.

It is often forgotten that the formal training of HE teachers is a comparatively recent departure. There have been programmes around for a couple of decades, but these have largely been voluntary, for example the SEDA programmes. Indeed HE teaching is one of the last professional areas to be formally required to train their staff. The learning outcomes for most ISD Postgraduate Certificates evolved from these forerunners, but they are usually generic - indeed it is only in recent years that such learning outcomes have referred to discipline-based input. The first UK Maths Postgraduate Certificate was that introduced by the Warwick Mathematics Institute in 2004. We suggest the following rather detailed list of learning outcomes for a Mathematics-department-based Postgraduate Certificate.

1. Subject knowledge:

- (a) Be fluent with the subject matter on which you are lecturing.
- (b) Know how the modules you teach fit into the structure of the degree - which level of knowledge you can expect from the students when you begin the module, and what other lecturers will expect of the students who have taken your module.
- (c) Pitch your lectures at a level which is appropriate to your audience, taking account of what the students can reasonably be expected to know, and be able to understand.
- (d) Fourth year MMath modules: be conversant with some current research in the area in which you are lecturing.

2. Communication skills:

- (a) lecture enthusiastically
- (b) lecture accurately
- (c) speak audibly and clearly

- (d) write clearly on the blackboard, taking care that your writing is sufficiently large that students at the back of the hall can read it, and using the blackboards in a sensible order, *or*
 - (e) display text by some other means, such as OHP or data projector, taking care to display each page for enough time for students to copy it down.
3. **Quality of exposition:** If you do not provide lecture notes or use a textbook, then what you write or display should provide students with reasonably complete lecture notes.
- (a) These notes should be organised in the standard way, with each new result numbered or named so that it can be referred to subsequently.
 - (b) In lectures and in Lecture Notes, theory should be leavened with examples, and students should be encouraged to make up and test out their own examples.
 - (c) You should take account of the fact that students may have different styles of understanding, and offer various approaches where possible, including heuristic explanations of difficult and technical theorems.
 - (d) Where possible you should use diagrams to convey or summarise information, and encourage students to draw their own diagrams. Although not all students appreciate diagrams, enough do that this is a technique worth developing.
 - (e) The material should be accessible to all or most of the students taking the module, with references to more advanced material to stretch the strongest.
4. **Exercises/Projects/Essays** Every lecturer should set exercises, projects or essays which oblige students to deepen their understanding of the module. Exercises should be set at several points during the term; in a ten-week module, students should not have to wait more than two weeks for the first set. In particular, they should set
- (a) enough very easy and routine exercises for even the weakest students to get some practice with the basic concepts of the module;
 - (b) enough exercises at a middle level, whose solution is within the reach of most students, though requiring serious thought and effort, to oblige the students to understand the material;

- (c) some exercises which will challenge and excite the brightest and strongest students, and provide opportunities for them to deepen their learning beyond the demands of the syllabus;
- (d) where appropriate, exercises which display links with other modules, and draw on students' knowledge of other modules.

5. Assessment

- (a) If resources are available, some exercises should be marked for credit, in a proportion consistent with the department's conventions.
- (b) The final exam should be designed to ensure a spread of marks, consistent with the department's conventions, with parts of each question testing
 - i. book knowledge;
 - ii. the ability to perform standard calculations or elementary deductions of a standard type within the theory;
 - iii. the ability to solve previously unseen questions (to give the strongest students the opportunity to distinguish themselves).

6. Organisation

- (a) Start and finish lectures on time, taking care to observe local norms.
- (b) Make clear to students the organisational details of a module: syllabus, modes of evaluation, book lists, module description for course booklets, etc.
- (c) Make module material available and accessible to students via the internet or by producing and distributing printed copies.
- (d) Obtain and respond to feedback, student evaluations, etc.
- (e) Organise and support TAs if they run support classes.
- (f) Be available to students outside lectures, either via e-mail or through regular office hours.

The above could be fairly easily adapted to most provisions. Most of what it contains is fairly obviously desirable. In case you, the reader, feel that the lists contain too many obvious points, we offer the following

Local falsifiability criterion: An item deserves its place in the list if you have ever come across a lecturer, in your university or somewhere comparable, who did not achieve what it describes.

We have applied this criterion to our list! It is, of course, a quite different matter whether giving a lecturer the list would have brought about the necessary improvement. Nevertheless, a list of this kind can be useful. It can guide lecturers in what is expected of them. It can provide a checklist for observations, potentially the most effective part of the any training, reminding the observer what to look out for. And it can provide a written statement underpinning departmental insistence where a lecturer does not teach to a satisfactory standard. This may be invaluable in case of a dispute. The first and third of these reasons make it plain that the Head of Department should endorse any list of outcomes that you adopt as a description of what the department expects.

3.8 Questioning Assumptions

Like all interpersonal activities, much of our teaching is based on unconscious assumptions, and, especially where lecturers from other backgrounds are concerned, it is important to question these assumptions. Activities should be planned to encourage this.

Because of the nature of unconscious assumptions, it is impossible to make a complete list, but here are some which we believe should be brought to the attention of new staff.

1. For many years it was assumed that the experience of having been a student was all that was needed to enable an academic to become a competent lecturer. For reasons which have already been discussed in Section 1.4, the assumption is less prevalent than it was. How justified is it?
2. Most other European countries have a much more Darwinian approach to student success and failure than is normal in British universities. It is expected that a significant proportion of students will fail at some point in their first year, and this winnowing is regarded as a normal part of the selection process. The need to select out the bottom 20 or 30 percent gives rise to a quite different attitude to struggling students than is currently acceptable in the UK, where selection is regarded as taking place before the degree begins. On the other hand, this latter approach to selection may not be ideal, and could also be questioned.

3. New staff have been academically successful in a way that it is not reasonable to expect many, or even any, of their students to be. They may have taken their undergraduate degrees in mathematics departments where the intention of a significant proportion of the students was to go on to a PhD and an academic career. It is important to recognise that these may not be realistic aims for their students now, and to find out about, and learn to respect - or to understand sympathetically - the aims and aspirations of these students.
4. The structure of the curriculum may differ significantly from what the lecturer is used to, or thinks is sensible. Second year students may not have studied all of the material that the lecturer thinks a first year student ought to know, and, even more seriously, beginning first year students may not know all of what the lecturer thinks of as “school mathematics”. The answer to this, of course, is for the teacher to educate themselves on the background of their students.

3.9 Needs Analysis - Designing an Individual Training

Ideally a training programmes should begin with an analysis of the needs of the new staff. This may be a formal process in which the new staff member fills in a form describing the areas in which he or she wishes to develop, or it may be an informal chat with a mentor. The Coordinator can then plan a sequence of training activities. ISDs catering to all new staff in a university will typically run a large number of generic workshops, on topics like Teaching Large Classes, Curriculum Design, Varieties of Assessment, Using your Voice, The new staff member can chose from these with guidance from the Coordinator.

Needs will of course vary, depending on the type of teaching to be carried out as well as the individual being trained. In a department with a strong tradition of teaching and plentiful teaching materials, one of the main requirements of a beginning lecturer may be to familiarise him- or herself with the material relevant to the first modules they will teach. A new department, or one undertaking new teaching, may instead need its new staff member to study the programmes of other institutions.

Anecdotal evidence suggests that the needs analysis should be managed

with tact and care. New staff may be surprised to be met with such a requirement, especially if coming from abroad. They will not necessarily view it with respect. In almost all UK Mathematics Departments, the overriding pressure on new staff is to develop their research. As a result, they may devote only cursory and sceptical attention to the teaching related needs of the new lecturer.

The situation can be improved by early action of the Coordinator. If the new staff member can be made to feel part of a teaching community whose values and aims are successfully projected as worthy of respect, then he or she will be less inclined to see the needs analysis as merely a bureaucratic requirement. The attitude of the Head of Department is also crucial here, as it is throughout the new staff member's initiation to teaching.

We should also remember that the lecturer often has 'hidden' needs, in the sense that they don't always know what are the right questions to ask. They only become aware of these when a problem arises in the classroom. One of the jobs of the department should be to anticipate these, as far as possible, from its greater experience. This is one reason why some kind of induction session is needed before the lecturer is exposed to the perils of the classroom, and why it may be a good idea for the new lecturer to do some teaching before carrying out the needs analysis.

A departmentally based programme is clearly not able to offer participants a choice of workshops. Instead it should run a small selection of events which all participants should attend, and which should be open and attractive to others. Part of the strength of a departmentally based training is its ability to foster a teaching community and encourage discussion of, and interest in teaching, and this is only possible if participants attend the same events. Restricting the range of events participants can attend is a price well worth paying for the increased usefulness of subject-specific training.

Some space should be left for participants to attend events run by the ISD, both for political reasons and because specific generic events may be exactly what is needed - we are thinking of workshops on using your voice, for example.

Departments must be willing to take into account the training and experience that new staff may have gained from previous jobs. We discuss this further in Section 7.4.

3.10 Keeping to a schedule

New staff often have to complete their training in order to satisfy the requirements of their probation. Thus they have a strong incentive to complete. On the other hand, they are also busy meeting new challenges, and preoccupied with getting their research going in a new environment. So they have a strong incentive to procrastinate. It is possible for the Coordinator to feel responsible for shepherding them through the training, and then to lose a lot of sleep worrying about it. To avoid unnecessary stress, we strongly recommend that the Coordinator should make the requirements and schedule of the programme as public and accessible as possible, for example by running a website where all the details are clearly displayed. He or she should then arrange for the necessary reminders and enquiries about progress, to be circulated by clerical staff. It is important for the Coordinator to put such a system in place. Once this is done, new staff should be told that it is their responsibility to complete the training, and not the Coordinator's job to chase them.

3.11 Assessment of the training

In practice it is almost certainly the case that formal summative assessment, usually by portfolio, is in the hands of the ISD in your institution. What follows is our view of how formative assessment might in principle be carried out.

Assessment is a thorny topic. At the moment, the suggestion that new lecturers should sit exams to assess the effectiveness of any training they participate in would be met with ridicule from most academics. But there is no doubt that some form of assessment of a programme of training and education is essential. Imagine teaching a mathematics module without assessing it in some way - how could one judge whether the students have learnt anything? We all know that non-assessed coursework is as good as wasted on most students, since they don't do it!

And how confident would one be to get on a plane, knowing that the pilot had been on training courses that were not assessed? This is precisely what, until recently, most universities expected their students to do. If the lecturer needed to learn about setting exams, they might go on a staff development course for an afternoon, doze through the talks, participate resignedly in

the activities on offer, and comment soothingly on the feedback form. They then might return to the office without providing any input at all, or giving any evidence that they had actually learned something from the experience. With the advent of teaching certificates in HE this is no longer considered adequate. So what kind of assessment is necessary, and what is possible?

The White Paper and the Professional Standards Framework (Section 2.1) leave institutions free to decide how to assess the results of training, subject to accreditation. As educators, we are presumably experts at least in certain forms of assessment, though not necessarily of the kind of qualities we are looking for in lecturers. But decisions about assessment cannot be isolated from the issues of recruitment, legitimacy and collegiality.

Recruitment is in crisis:

“If university managers are to deliver the high quality we expect from higher education, it is essential that institutions are able to recruit and then retain staff of the highest calibre. The recent annual HEFCE survey provided evidence of a worrying rise in unfilled vacancies across the university workforce. Among academics, particular recruitment difficulties were reported in a range of subjects (IT/computing, business-related subjects, professions allied to medicine, science, and engineering) where higher salaries were on offer elsewhere. At the same time, as reported in the recent Roberts review, there are anecdotal reports of a decline in the quality of new applicants for academic jobs.”³

Young academics have to spend several years in fixed term positions, as postdocs or temporary lecturers, between completing a PhD and achieving a stable permanent position. A permanent position is by no means assured, and only the most successful are free from the anxiety that at the end of five or six years of temporary positions they might simply find themselves out of a job. Academic salaries have lagged significantly behind the salaries of others with comparable or even shorter training and less stringent entry requirements - doctors, chartered accountants, lawyers. British universities are, increasingly, relying on foreign academics to staff them.⁴ Therefore assessment of training must be sensitively implemented. We believe that to add another significant and uncertain hurdle to the path to stable employment would exacerbate the already severe shortage of new entrants to the

³[9, Paragraph 4.20]

⁴Statistics and comments on the crisis of recruitment can be found, for example, in [29], published in April 2002, especially in Chapters 5 and 6.

profession. In particular assessment regimes that carry a serious threat of termination of employment cannot be implemented in academic staff training without giving rise to counter-productive bad feeling, whether this training is carried out by a central staff training body, or within individual departments.

So the assessment of staff training in teaching should be realistic and practical. It should be designed to maximise learning and engagement, but it should not be a filter or a block to professional advancement. It should oblige staff to take their teaching seriously, and to think seriously about how to develop as teachers, but it should not function as a means of correcting ill-advised hiring decisions. If universities care about teaching, they should make sure that they examine the attitude and aptitude of applicants at the time of hiring. Job candidates can be asked to deliver a sample undergraduate lecture, or otherwise demonstrate teaching ability. Although research-intensive departments may inevitably focus on the job applicant's research abilities, a sample teaching lecture also allows an applicant to display brilliance and originality. Some institutions already do this, and there are examples of the best candidate on research grounds not being appointed because of inadequate teaching ability.

It should be possible for every new staff member to complete the training by investing reasonable effort. Though once again, let us flag up the fact, to which we do not offer a response (beyond the effort we have put into writing this book), that roughly half of our job is teaching, but the means by which our suitability and performance is measured are vastly greater in research than in teaching. Perhaps a measure of 'reasonable effort' could be modelled on what we typically demand of students - we all know that we have little truck with the student who fails their course because '...they didn't put in any effort'!

Most universities sidestep these questions by making completing the training a necessary condition for passing probation. This postpones until the end of the probationary period the effect of a failing grade in a training programme. The decision on termination of employment is in the hands of a probationary review body rather than the staff trainers themselves. Nevertheless, we believe that the effects of a punitive assessment regime would be damaging.

However, any training programme must demand something of its participants. They must question their assumptions; they must examine their own teaching critically and objectively; they must read about teaching and learning; they must attend talks and workshops. *There must be some way of*

checking that they have met these demands. If there is none, then however well-intentioned the lecturer, the demands of other activities where evidence of success is required - in other words, everything else that the lecturer has to do in his or her job - will lead inevitably to neglect of the training. The trainee who is not asked to do anything is in a similar position to the lecturer attending another colleague's lectures out of a desire to learn the subject. Unless we submit to the discipline imposed on the students, going through our notes and doing the exercises each week, we become increasingly detached, and quite quickly lose our grip on the material.

We believe that assessment should be carried out by means of a portfolio which the new lecturer accumulates over the year or two years that he follows the training programme. This is a standard methodology in ISD Postgraduate Certificates, on which there is copious literature. It would seem sensible for the Coordinator to discuss this issue with their ISD and to come to an agreement about what is required for a portfolio.

Who does the marking? Allocating marking duties implies of course another resource demand, and this needs to be recognised. The task could involve marking anything from a 2000 word essay to something closer in size to a Master's dissertation, and such comparisons can be used to determine what would be an appropriate time allocation for such marking. In any programme, whether departmentally based or wholly generic, there should be two markers, one from the central ISD and one from the department. Of course the first requirement for markers is that they should be qualified to do the job! This alone may restrict the possible candidates. As with allocating mentors, one has to strike a balance between overloading particular individuals and ensuring that only committed, conscientious markers are recruited. It would be preferable to have one good, dedicated person marking two project reports than to have one marked by an inadequate marker. But then of course the extra load on the person recruited must be recognised (which, sadly, does not always happen).

Chapter 4

Observing and mentoring teaching

The support of new staff

This is an area where ISDs do have a lot of expertise and produce abundant generic material. We do not want to replicate this, but just to put a maths slant on it.

Every lecturer has been a student, and even beginning lecturers have a wealth of experience of watching other lecturers at work. As enthusiastic and committed students, almost all will have formed clear views about teaching. In our experience most new lecturers take a conscientious approach to their teaching, care about their students and are willing to learn. They may even have some advantages over older staff: they are more often passionate about their subjects, and able to transmit their enthusiasm; and they are closer in age and experience to their students. The aim of staff training should be to capitalise on this experience and enthusiasm build on it.

However, high academic achievement, youthful enthusiasm and good intentions do not necessarily imply good teaching.

In fact new staff come in many shapes and sizes, and, increasingly, with different levels of involvement in teaching and different backgrounds. A crucial requirement of staff training is therefore flexibility and responsiveness to the needs and abilities of new staff. It must provide support and advice to new lecturers where they have difficulties, without forcing this support and advice on those who don't need it. And it must enable new staff to develop their skills and to integrate them into the activities of the institutions where

they work.

4.1 Beginning teaching: the first teaching duties

We suggest that each new lecturer should build their training around two modules¹, although these may not be the full extent of their teaching. They may be the first they teach, if they want to complete their training as quickly as possible. If there is less pressure to complete, and the new lecturer's teaching skills are not obviously deficient, it may be a good idea for them to do some teaching before beginning the training. In this case the Coordinator should arrange a preliminary teaching observation, which need not be included in the final portfolio produced for the assessment of the training. New lecturers are often talented and enthusiastic teachers, though of course this does not mean that they have nothing to learn. And they often have other preoccupations when beginning a new post, principally with regard to their research. Obliging them to undergo training at this point may be counterproductive. On the other hand, many probationary staff are anxious to complete probation as soon as possible, and will undertake anything which will bring this about. And some departments may require new staff to begin their training at once. However, where possible, if they can be gently persuaded to hold back on the training for a term, this may be to their advantage. The training will be more meaningful if they have some months of teaching experience to weave it into.

Nevertheless, there is a caveat to the above. The prime concern should be for the students that the new lecturer has to teach. If there is any doubt at all about the new lecturer's teaching then it should be carefully monitored.

The two modules on which the training is focused should develop different skills.

One of them should be an optional module, at a high level, close to the lecturer's research interests, and taught in the third or fourth year of the undergraduate programme, or in the MSc. It may be a new module of the lecturer's own design, or it may be an existing module in which, nevertheless, the link with the lecturer's research area is clear, and in which the lecturer

¹How long is a module? We mean a term's worth of teaching in one subject - perhaps 30 lectures or their equivalent in classes or lab sessions

has the opportunity to modify the syllabus in line with his or her interests. The audience will be small, able, and highly motivated, and therefore less at risk from problems due to the lecturer's inexperience. The lecturer should in any case minimise this risk by providing a comprehensive reading list, for students' independent learning, and providing extra support and consultation.

The other should be larger and at a lower level, perhaps one which all students have to take. It should be a pre-existing module with some departmental tradition and experience, which the new lecturer will have to come to grips with in the process of teaching it. This is not to say that he or she should not take a critical attitude towards it, but should do so at the same time as making efforts to understand its place in the undergraduate curriculum, and the rationale for its current form.

The order in which these two modules are taught should be decided in consultation with the new lecturer. For some, lecturing to advanced students in an area close to their research interests will be the most fruitful introduction to teaching. For others, a course of the second type, with its pre-existing structures and course materials, will provide a better base from which to begin. Taking into account the new lecturer's needs and strengths will produce the best outcome both for them and for the students they teach.

In any case, these two modules will be the focus of the new lecturer's departmental training. For each, they and the Coordinator should choose a *module mentor*. This should be someone with relevant subject knowledge, who has previously taught the same or a related module. Ideally it should not be the lecturer's departmental mentor², as this might create conflicts of interest. It is important that the coordinator should be involved in the choice. The new lecturer is likely to regard the training with less respect than the coordinator, and to have little idea of the benefits of having an experienced and critical colleague in the audience. Where the coordinator leaves the choice of module mentor to the new lecturer, all too often they will choose someone who they expect will make few demands on them. The coordinator's role is crucial in helping to make a suitable choice, and in explaining to both mentor and mentee the significance and value of their relationship. The university's ISD may be able to offer some preliminary

²Many departments appoint a mentor for each new member of staff, independently of any training, with the brief of looking out for their well-being in all aspects of their professional activity.

training to module mentors; this is an area in which their generic skills can be very valuable.

The module mentor will meet with the new lecturer at various stages:

1. before the module begins, to discuss the syllabus and objectives, and to help the new lecturer gain an idea of what the students will know when they start;
2. during the module, when the mentor will formally observe the new lecturer's teaching in action, making a written record of the observation. This is discussed in more detail below. The record should be made on an appropriate form which guides both the lecturer and the observer in what is required. These records of teaching observations should form part of the new lecturer's portfolio. One observation per lecture-course may be enough, but the mentor or lecturer may decide that more observations are needed.
3. when the new lecturer sets the module exam - the module mentor should check it for accuracy and appropriateness, and help the new lecturer improve it where necessary.
4. after the exam has been marked, when the new lecturer will be most aware of the successes and failures of his or her teaching, to discuss and review the module.

This arrangement should be flexible and responsive, adequate to the mentee's needs and sufficient to guarantee satisfactory progress in developing their teaching. Where there are difficulties, the module mentor should be prepared to play an active role, advising the new lecturer and visiting their lectures more than once. The primary responsibility of all university departments is to their students, and in fact a flexible arrangement like this, which is able to concentrate help and support where it is needed, is of more benefit to students than an arrangement which obliges all new lecturers to sit through the same training sessions, irrespective of their skills and talents.

4.2 Experiences of mentoring

To set the scene as it is in practice, we have surveyed colleagues and gathered experiences of mentoring and observing teaching. The full texts may be

found on the book website (url); here we will pick out the main points that commonly arose.

The role of the mentor or observer

A common thread that emerged in various guises was uncertainty about the role and the status of the observer. This is a very important issue to which we devote the next section.

- *‘In peer observation of senior colleagues, the observer lacks authority’*
- *‘It’s not really worth mentoring the likes of Y who we’re going to hire anyway because of his splendid research and who is a competent teacher but with no real desire to give students not fully committed to mathematics as positive an experience as possible. He is a brilliant teacher for budding mathematicians’*
- *‘It is probably pointless to watch someone twice unless there is a serious problem whose resolution (or otherwise) one can try and observe’*
- *‘However, at no time had anyone observed her teaching (it being assumed her previous experience in her home country covered this), and it was only later through informal student complaints that it became clear that there were a lot of problems with her classroom teaching, mainly arising from her non-native language and lack of knowledge of the UK system.’*
- *‘We need a short presentation to staff about why it is in our interests to be good teachers and the observer’s role in peer observations’*
- *‘Here was a case where the lecturer was very keen and willing, had prepared his content well, but was let down by lack of basic classroom skills, which a few teaching observations were able to put right.’*

Here the respondents highlight the need for clarity about what the actual purpose of the mentoring and observation is. Is it a minimalist task of ensuring that the students are not actually outraged? Is it to ensure that the mentee develops into a good teacher? Is it unnecessary for a foreign lecturer with previous teaching experience? Has a senior colleague really nothing to learn from observation of their teaching? The mentor or observer needs to

be very clear on such matters and be certain about the task they have to do and the skills needed to do that. Also, they must be respected and supported by the department in that task. They need to be aware of the needs of the mentee and how they can fulfil those needs.

Sensitivities in mentoring and observing

The above quotes also hint at another important aspect of mentoring and observing - its sensitivity.

- *‘An observee can get very defensive when her teaching is criticised. This could be a sign that she cares a lot about her teaching and is upset that her best effort is falling short of the mentor’s standard. In that case, the mentor should take advantage of this positive point and reassure the observee that the comments are meant to help the observee achieve her goals.’*
- *‘Perhaps some form of sanction if he turned up late to a lecture might have had some impact!’*
- *‘He was a very conscientious guy and had tried his best and thought he had done a good job and was devastated at the students’ response. I sat in on his next lecture, and had to agree with the students that it was appalling, but it was not for want of trying on the lad’s part. He was very earnest and enthusiastic, and had prepared good notes for the board. But he made every classic mistake in the book.’*

Here our respondents exemplify some of the delicate issues that mentoring entails, and the need for the mentor to remain objective and entirely focused on helping the mentee to develop. The mentor needs to think about what the response to their comments might be and how to make them as effective as possible. And even though an observee may really need pulling up on something, the mentor must be able to do this tactfully and sensitively.

The time required for mentoring and observing

This can be a thorny issue. One has to ask whether a mentor who regards it as onerous at all should really be mentoring. On the other hand we are all busy, mentors and mentees alike, so the process should be as efficient as possible.

- *‘Each observation session occupies about two and a half hours, including a 10-15 minute meeting prior to the observation, follow-up discussion and writing up the report. Mentoring a colleague for one term takes 8-10 hours.’*
- *‘You could cut down on the time (as much as 45 minutes per observation) by not insisting on written reports which is the part I hate most and the part that is LEAST effective, because the issues would have already been discussed with the observee. Of course, documentation is necessary for follow-up observations but perhaps this ought to be reserved for the truly problematic cases.’*
- *‘I think teaching is important and therefore spending time on mentoring is time well spent, when it’s effective’*
- *‘I start from the assumption that teaching is a major part of our professional lives and is something that we should approach with pride. At the same time I also recognize that most academics in our Department are research-driven and that any procedure designed to improve teaching standards must recognize this fact, if it is to be successful. It should be clearly useful to mathematicians, and not burdensome in time.’*
- *‘I spent two–three hours on the observation and discussion of a lecture (preparation, lecture, debriefing).’*
- *‘I went to three or four lectures of his course on _____, talking to him before and after, but fairly briefly.’*

Our respondents all follow the usual pattern for actual teaching observation - before, during and after. This is fairly quantifiable. The general task of mentoring, acting as adviser, possible trouble-shooter, etc can be more open-ended.

The effectiveness of mentoring

We found some very pragmatic attitudes to this.

- *‘I think I was effective with X (he may not have benefited much himself - he did not get a permanent job - but I think his students benefited from his improved exposition), less so with Y. Z has said that he found my comments on his teaching useful.’*

- *‘I did get the impression of some improvement. It was essential !’*
- *‘He either faced the board or buried himself in his notes. He stood in front of the board so students couldn’t see it, and spoke in a monotone, if shrill, voice. He never once engaged the students and focused entirely on writing down pristine notes on the board, which the students couldn’t read. Straight afterwards I pointed out all these common errors. He was very keen, learnt quickly, and the next lecture he was vastly improved. We went through a few more things, which he took on board, and by the next lecture I was quite confident to leave him to it. In fact he soon turned into an excellent lecturer and within a year was one of our most popular lecturers. ... But the point is that for a couple of weeks the students suffered. This could have been largely avoided by a simple mock lecture before the start of the course.’*
- *‘In fact, after the event, it took quite a lot of work to improve her teaching to an acceptable level. The point here of course is that she had still been able to avoid the ISD teaching certificate, and become a member of the HEA, while still teaching below a satisfactory level.’*

So our respondents appreciate that they may not always be effective with some lecturers, and indeed mentoring can sometimes be a frustrating and thankless task. On the other hand it can be very rewarding when you find you have made a real difference to a person’s professional and personal development - and of course for the students they teach.

Who should mentor and observe teaching?

We say quite a lot about the characteristics required of a good mentor or observer, but our respondents highlight a particular aspect of this issue which is worth mentioning here. What role can ISD staff play in actual mentoring and observing? In previous sections we have argued that the role of such staff in training mathematicians is limited. Nevertheless, in observing lectures, their training and experience can come to the fore. In our experience they generally have a lot more to say about lectures than do most mathematics department colleagues! Although not necessarily able to comment in detail on the quality of the content, at their best they may well have helpful things to say about generic issues such as the use of the voice, blackboard and other media, how to encourage student participation, and how to solicit helpful

feedback. However, experiences are very varied, and some of our respondents reported a dogmatic insistence on modern technology (PowerPoint and its variants) and a narrow-minded concern with rather arbitrary rules of good practice.

- *‘The Capital Centre have occasional training sessions on acting techniques applied to lecturing etc. that could well have helped – or indeed individual coaching by one of them. I think a period of guidance on voice production, standing up straight, looking the audience in their eyes, was needed and the Capital Centre have that expertise – we do not.’*
- *‘I once mentored a Postdoc taking on his first class - a hundred first year engineers. In preparation he was sent on a weeks course for new lecturers at the Staff Development Centre, and I assumed he would therefore be well prepared for his first class. Within minutes of the end of the first class students were knocking on their Senior Tutor’s door complaining about this new lecturer. When I asked him what had gone wrong, what did he learn at the week away we had paid for, he said that that had been all about the ‘theory’ of teaching, not about what to do in the classroom.’*
- *‘As part of the requirement for a reflective essay he submitted one of his MSOR Subject Centre articles on teaching. This was rejected because it didn’t show sufficient reflection on his teaching. This happened twice. Each time he was able to reverse the decision - how was it possible to write an article on teaching without reflecting on it? The point here is that he had to waste time arguing with what was clearly inflexibility and lack of understanding on the part of the ISD. He was lucky in that he was supported by a very senior member of the university, the outcome might have been different otherwise.’*
- *‘A foreign lecturer doing the ISD’s Teaching Certificate had a number of uncomfortable experiences with his ISD tutor. His first teaching observation was his very first lecture on (for him) a completely new course, given to him at short notice because someone had left. He had little idea about the background of the students, or how they would take to the course, so he didn’t prepare any material for the first lecture, deciding to use it to get to know the students and their backgrounds’*

and to gently introduce them to the topic, with a general overview. His ISD observer told him this was unprofessional, not to prepare learning materials before the lecture. He would let it pass this first time but expected something for the next time he observed.'

- *'When he was next observed the ISD observer again accused him of lack of professionalism because he wasn't using Powerpoint.'*
- *'There is a danger that if we over-formalize and vocationalize our teaching, seeking to label every skill and weigh them critically in a scientific or accountancy way then we may lose sight of what teaching really is. One thing is sure, here is a case where the generic, non-mathematician observer, is incapable of seeing the wood for the trees, and cannot make judgements on the teaching.'*

4.3 The role of the mentor

The mentor's job is important and can be difficult and time-consuming. It can be hard to persuade staff to take it on. If it is seen as merely another bureaucratic requirement with no real value, then it will not be willingly undertaken. Here it is important for the coordinator to stress the flexibility of the commitment. It will only be demanding if it is valuable. For a well-delivered lecture-course, a single visit may be enough. But if there are any problems at all then more visits will be necessary. Experience at Warwick suggests that the mentor can make a crucial contribution when things go wrong, and one which any department which takes seriously its responsibility to students should be prepared to make. The presence of an experienced mentor, advising an inexperienced lecturer, can save a module from disaster. In the hopefully rare cases where the mentor has to make a significant contribution, the department should find ways of recognising this subsequently, perhaps by reducing the mentor's administrative load in other areas.

At the moment, few universities provide training for the specific role of discipline-based mentoring. No-one is yet an expert. This is always the case when a completely new professional activity emerges - we have to pull ourselves up by our bootstraps. It need not take long. We can learn from our neighbours, and the university's ISD would be a good place to start. As a department develops its own training programme, its members will develop the necessary skills.

And as well as mentoring skills, the department has to have a teaching culture it is proud of and wants to impart. If it does, then it is likely that staff members are themselves competent, and capable of setting good examples to new staff, and helping them to develop. Mentors will have skills to impart and can advise new members. Again, as well as technical aspects of training, mentors should have good interpersonal skills and concern for students, and the department will value people with these skills as leaders in training. The Coordinator and the module mentors can take available courses, if only as observers, in order to meet others involved in training and share experiences. The annual MSOR Induction Sessions in Birmingham are worth attending for this reason.

As part of his or her preparation for the role, a module mentor should be given a clear statement of the qualities of teaching they should be looking out for and encouraging. Section 3.7, on Learning Outcomes, has already addressed this theme.

4.4 Teaching observations

Teaching observations are among the few activities of generic training programmes that are regarded as worthwhile and helpful by most participants. They are also crucial in ensuring that new lecturers are competent to teach. Demonstrating a reasonable level of competence in teaching must be a necessary condition for completing the training.

We distinguish four types of observation:

1. Each of the new lecturer's first two lecture courses should be observed at least once by the module mentor. Once may be enough, if all seems to be going well, but the mentor may wish to visit again if he or she has suggested changes and wants to check on their implementation.
2. If the training is accredited via a generic training programme run centrally, then lectures should also be observed by someone appointed by the university's ISD, as part of the necessary verification of teaching competence. In fact such observations are often extremely helpful - whereas ISDs may be hard put to produce workshops of value to audiences from widely differing subjects, their members often do have real skills in discussing concrete practice in a one-to-one relation.

3. Participants in a training programme can observe one another. The change of roles may be helpful to the new lecturer.
4. Besides *being* observed, new lecturers should also have the opportunity of observing an experienced colleague's lecture. This is especially valuable if the observed lecture is part of a lecture course that precedes, or follows on from, a course that the new lecturer himself is giving. Quite apart from any benefits that come from seeing an experienced colleague perform, the new lecturer will profit from seeing how what he or she is teaching fits into the degree sequence.

The results of each teaching observation should be recorded on a suitable form, containing

1. a preparatory section in which the lecturer described what he or she intends to do, and what he would like to the observer to comment on, to be completed before the observation takes place.
2. Space for the observer to take informal notes during the observation
3. A section for recommendations and conclusions (this may be omitted in the case of observations of type 4).

Usually either the observer or the observee arranges a preparatory meeting to discuss the criteria, purpose, and conduct of the observation. It's useful to clarify, perhaps on the observation record form, whose responsibility this is. The lecturer being observed might ask the observer to take particular note of certain points they are specially concerned with: response to students' questions, audibility, explanation of tricky points and so on.

De-briefing after the observation is of course essential, and the advice for the observer here is very similar to what one might say about individual feedback to a student: don't begin by telling them what they have done wrong. Discuss with them how it went generally, mentioning good and bad points. We are all much more sensitive to criticism than probably we should be, and this is especially the case in activities which, like teaching, have a strongly social aspect. Tact is an important ingredient in getting your message across.

Don't overload the observee with feedback - concentrate on the major areas that need attention. If there is more to comment on than can readily be digested by the new lecturer in one session, then probably a second

observation is called for. The observer needs to remember that they do not necessarily have all the answers, or at least all the answers that are practical for the new lecturer to take on board. A particularly important instance of this arises when the observee has problems controlling the class. An experienced teacher will have knowledge and tools for dealing with this that are most probably inaccessible to the nervous new lecturer. The reasons for lack of control may range from boring, unsympathetic lecturing to a small core of badly behaved students. The observer needs to identify precisely what the problem is and discuss with the new lecturer what they think is practical for them to do about it. The best advice may be to refer the observee to another member of staff who is known to have just the right expertise to deal with the situation.

On the other hand, one should not be afraid of alerting new staff to deficiencies in their teaching. For example, some are incapable of getting onto a student's wavelength and do not appreciate that this might not be because the students are weak, but because their explanation and teaching skills are poor. Some can't write a reasonable length essay (and yet will expect their students to do so). Some complain about the students' lack of interest or willingness to study the topics that interest the lecturer, and yet strongly resist any activity that does not interest them!

The observer must remember to watch not only the lecturer but the audience too. Whereas everything the observee says is likely to be clear to the observer, for the students it is all new and much of it may be incomprehensible. The observer must be able to put him or herself in the students' place and learn to think about how it all sounds to them. For example, the lecturer's language may be too sophisticated; if they refer to a "piecewise-continuous function", are they sure that the students appreciate this readily enough at the speed of the lecture? As a detached observer you might notice clues to this: puzzled looks from some students, whispers to their neighbours, etc. So you have to watch the students as well as the lecturer.

Traditionally, peer observation consists of sitting discreetly at the back of a lecture hall, hoping you won't be noticed. People often shy away from carrying out teaching observations in tutorials because it is thought that the observation will interfere with the process - it is difficult to hide in a group of five tutees! This is of course a problem if the observation is for formal summative purposes, but need not be when the purpose is to help the new lecturer develop. Then there is no harm in another lecturer joining in the tutorial, provided all agree.

There is a lot of literature on the benefits and protocols for such observations. Practically every university in the country has a website describing its approach, and a Google search for “Teaching Observations” throws up a vast numbers of sites.

Finally, let us mention that one of the most important aspects of a mathematics lecture course is the exercises that the lecturer sets. A teaching observation should pay some attention to this as well as to the lecturer’s performance during the class.

As a variation on teaching observations, lecturers can have one of their lectures videoed and then watch the video with a mentor; this is likely to be a valuable experience, though disconcerting.

Chapter 5

Workshops and seminars

5.1 Attracting an audience

Understanding how their new department works can be as important to a new lecturer as learning about how to teach (see Section 2.7). The departmentally based component of staff training is especially valuable for this reason. Workshops and discussions which attract established staff as well as new help the two groups to make contact, and give the latter the opportunity to benefit from the experience of the former. They may also give established staff the opportunity to discuss aspects of teaching and departmental practice that they do not normally have. Because of the benefits of bringing together new staff and old, it is worth trying to run events which offer something to established staff as well as newcomers. First on the list of successful inducements is, of course, food and drink. A reasonable supply of each can help to establish a friendly and relaxed atmosphere in which discussion can thrive. Don't leave the refreshments till the end - they do the most good if they are consumed during the meeting! They can help to keep a late afternoon meeting going beyond the point at which staff would have gone off to eat otherwise.

Not surprisingly, another way of attracting established staff is to run workshops and meetings on topics that are likely to interest them. A workshop entitled "How students understand proof" will probably appeal only to the very committed, but something on a topic of recognised departmental concern - "How can we increase our student numbers and avoid closure?", or "The balance between Analysis and Algebra in the first year curriculum"

- may well attract a larger public. Although such meetings may not at first sight contain any element of training, the experience of participating, with established colleagues, in a discussion of significant issues of departmental policy and practice, can be extremely valuable.

A strong argument in favour of departmental rather than central staff training is the possibility of running subject-specific workshops and seminars. However, most departments do not have enough new staff to provide, on their own, a reasonable audience for such events every year, and this has been one of the main arguments in favour of leaving the running of workshops to the university's ISD. So what can be done? There are several approaches to the problem.

1. Run events which attract not only new staff but old hands too, as described above. If appropriate to the topic, invite interested students. Events with a wider range of participants than just new staff can be very valuable. The *Undergraduate Learning and Teaching Forum* described in the list below is a case in point. Another example is the annual discussion meeting, open to all staff in the department, which we have run at Warwick for the last five years. Each year a different topic is chosen through consultation with staff. Exposing new staff to the issues of debate and uncertainty in the department is an excellent way of recruiting them to active participation. The discussions are reported on the Warwick website at <http://www.warwick.ac.uk/masbm/PCAPP/Events/Forum/forum.html>.
2. Run different events under the same rubric. The annual discussion meeting just described is a case in point. The deeper benefit to new staff from participating in these events is the same each year, only the vehicle is different. So it is quite legitimate to count it on the list of compulsory activities for participants in the training programme. There is no need for the sequence of workshops in the programme to be eternally the same.
3. Some events, such as the workshop on A-level maths which we now run annually at Warwick for the benefit of our largely foreign-trained new staff, can be run in conjunction with other departments, such as Physics, Computer Science, Engineering and Economics, whose undergraduate entrants are expected to have Mathematics A-level. This is, for example, the arrangement adopted at Oxford, where Mathematics

works with Science and Engineering in supporting new staff. Sharing activities with other departments may be a good idea in any case: a solitary new staff member may feel isolated, and might benefit from contact with other young staff. Such groups could be initiated and coordinated by the ISD with consultation with departments. This would provide a middle ground between purely discipline-based training and purely generic training

4. It is possible to share the organisation of events with Mathematics departments in nearby universities. Because of the travelling involved, it may be a good idea to alternate the location. Another possibility is that groups of new staff from neighbouring institutions could come together in regional centres coordinated by, say, the MSOR Subject Centre. Such an arrangement is made in the case of the Subject Centre's module *Supporting Postgraduates who Teach Mathematics*, and proves to be very successful. The main point is that once the department has identified specific training needs for their new staff, they may be able to meet them by collaborating with other departments within their institution or in their area, or with outside agencies such as the MSOR Subject Centre. They do not have to provide everything themselves.
5. Run some parts of the training programme in alternate years. Many new staff postpone by a year or two the start of their training in any case, so will not necessarily feel deprived. A good staff development coordinator can alert new staff to pressing issues if the workshops which deal with them will not take place for another year, especially if he or she has been involved in assessing the real training needs of new staff in preparation for a departmentally based training programme.

5.2 Themes and topics

Most departments have plenty of teaching issues that would provide good subject matter for workshops or seminars. The Warwick Mathematics Institute has run a number of such events, some of which are described on the website at www2.warwick.ac.uk/fac/sci/math/pcapp. Most were motivated by real questions that the department faced in its teaching. Here we describe a few in detail and refer to the website for the rest. We also give

some guidance to resources and people who may be able to contribute. We postpone to a second section a discussion of possible workshops on setting and marking exercises and exams.

1. A workshop on *current A-level maths syllabuses and examinations* - especially important for new lecturers from abroad, who did not receive their secondary education in the UK. To convey an operational understanding of what beginning first year students know requires the right balance of information and participatory activity. Simply outlining the syllabus will not be of very much use, though, unless participants can go away with a useable summary, together with a willingness to use it when preparing first year lectures. At Warwick we have a hands-on session run by Richard Lissaman, a Warwick Maths PhD who is now Deputy Programme Director in the Further Mathematics Network, a national organisation which sends peripatetic teachers to schools which lack the resources to teach Further Mathematics A-level.

Because the Further Mathematics Network is spreading across the country (there are now 42 centres), and its members roam far and wide in the course of their job, they provide a useful pool of potential facilitators for such events.

New staff can also gain an idea of what should be expected of incoming first years by sitting in on an A-level class in a local school. This also provides an opportunity for contact between school and university which may be valuable to both sides.

2. *Undergraduate Learning and Teaching Forum*. A group of about thirty undergraduate students from all years is invited to an evening meeting with the new lecturers over wine and a light buffet. Rather than order in a buffet from the university's catering service, we simply buy supplies from a local supermarket and invite everyone to make their own sandwiches. The cost of the food and wine for everyone is about £70. In fact a number of experienced staff come along as well, and the discussions have been relaxed and very enjoyable. The fact that established staff would be interested in attending was not obvious at the outset, but has come increasingly to the fore as more events have been organised under the rubric of staff training. The new staff, for whose ostensible benefit the event is laid on, provide a (more or less) guaranteed audience, but, as it turns out, a larger part of the audience

comes from existing staff who attend voluntarily. In the case of the Learning and Teaching Forum, finding the students can be more problematic. Efforts to invite a representative sample of undergraduates through our Staff-Student Liaison Committee met with no success - perhaps because students on third-class marks don't like to be identified as such - and in the end we were reduced to inviting personal tutees, and some of the front-row students from a lecture-course. As it turned out, knowing many of the student's names made it easier to moderate the discussion, and so the difficulty with their selection led to a positive outcome.

In preparation for the meeting, students are asked to make a list of five things they wish lecturers would do, and five things they wish they wouldn't do, and staff are asked to prepare similar lists regarding students' behaviour. The lists provide the basis for a discussion, which rarely flags.

3. *Teaching large classes* This is an area of real difficulty for many lecturers, and not only new ones. Classes have steadily increased in size in recent years. A class of two hundred requires a quite different style of delivery from a class of twenty, and much more careful preparation. Marking students' homework becomes difficult without a team of TA's, and it is necessary to find other methods of keeping students on the ball. For some ideas on this, see the account of Lecturer VI on the website [1].

Sources: Krantz [17, Chapter 2 Section 14]

4. *An update from Mathematics Education* Unfortunately much of the work in Mathematics Education is aimed at Maths Ed researchers rather than practising lecturers, so it is important to find a speaker willing to address practical questions in a non-technical way. Such people exist, and indeed Mathematics Educationalists are increasingly looking for ways of communicating with mathematicians. The paper [2] of Lara Alcock and Adrian Simpson is a useful step in this direction. It gives a convincing and thought-provoking analysis of some of the common cognitive dissonances which undermine student achievement in university mathematics, and could be used as the basis for a fruitful discussion. The authors would make ideal workshop speakers! Much of John Mason's book [23] is also concerned with these issues, and Mason

himself is an excellent speaker.

5. *Computer-based assessment and drilling (CAA)* Increasingly, computers are available for use in the practice of algorithmic skills. There are packages which generate exercises and even mark them. So far these are largely concerned with low level skills like differentiation and integration, solving ODEs, and various tasks of linear algebra. At the MSOR induction session held in Birmingham each year, Chris Sangwin (University of Birmingham) runs a workshop on Maple-based systems. Others involved in developing CAA are Trevor Hawkes (Coventry University) and Martin Greenhow (Brunel). In the US, Mathematica-based modules have been developed by a number of people - see the contribution to Steven Krantz's book [17] by Ed Dubinsky and Jerry Uhl.

At Warwick we ran a workshop which attempted to implement AiM (one of the Maple-based CAA systems) by producing material for some core undergraduate courses. In retrospect this was excessively optimistic - one of the outcomes was a widespread view among participants that CAA requires a more significant investment of time than they were prepared to make. Implementing something of this kind is extremely time-consuming, and if it is left to the individual lecturer responsible for a single module, it will rarely happen. If it is to be undertaken it may well require a departmental decision and departmental provision.

6. *The role of computing in the undergraduate degree* Some years ago the Warwick mathematics degree introduced a core first-year module called Maths by Computer. Its aim was to give students basic computing skills, and experience with a mathematical platform like MatLab or Mathematica with which they could explore topics in the other courses they were taking. For one reason or another, there was a general impression that it was not achieving its stated aim. The meeting we organised in response could have been held behind closed doors in a teaching committee, but held as it was in public, it gave the opportunity for a lively discussion which ended with a departmental consensus on changes to be made.
7. *Student passivity and what to do about it* This topic, and a general perplexity with UK student culture, comes up repeatedly in the pieces by new lecturers in Chapter 2.6. We ran a discussion on this as the

third of the discussion meetings, which aim to help new staff integrate into their department through an open debate on some aspect of departmental policy. We had two short and provocative talks from staff members on the problem of student passivity and possible remedies, and a lively discussion. The talks, like a number of outcomes from other workshops described here, are posted on the website ([33]) run by the Warwick training programme. See also the account of Lecturer VI in XXXX.

8. *Supervising PhD students* Workshops on this topic are often run by ISDs. However, it is not clear to what extent the same lessons apply to Mathematics, as, say, to a laboratory science, or to History. Mathematics PhD students rarely arrive with a PhD project in mind, whereas History PhDs generally do. Students beginning a PhD in a laboratory science are generally enlisted in the laboratory's ongoing research projects. The difficulty of judging to what extent students can be left to choose their own topic, and of suggesting a suitable topic for those who cannot, is a cause of much anxiety to supervisors in Mathematics¹, especially at the beginning of their careers. So this is an area in which there is a great deal to be gained by communication, especially at an informal level. In a recent open discussion meeting at Warwick, senior staff described their own surprisingly different approaches to these questions, and others intervened to reveal their difficulties and uncertainties. One unexpected result of the discussion was evidence of a growing dissatisfaction with the traditional British model of the PhD. Increasingly, foreign-trained staff want some of the same structures found, for example, in the US system – qualifying exams, advisory committees, and so on. A transcript can be found at www.warwick.ac.uk/~masbm/PCAPP/Events/Discussion/phd.pdf
9. *Dealing with students' problems in tutorials* What is the boundary between the role of the personal tutor and the role of a student counsellor? How much “counselling” should a tutor undertake, and what skills is it reasonable to expect him to develop? How could or should a personal tutor respond to a range of sample problems? Beside inviting experienced staff to talk about their experiences, it is worth also inviting a

¹See Lecturer XII, *The key question*, in XXXX.

member of the university's student counselling service, who will most probably be happy to have the opportunity to meet real live tutors.

10. *How to run teaching (as opposed to pastoral) tutorials* At many UK universities first-year students are expected to meet their personal tutors for mathematical, rather than personal, group tutorials. It seems that in general, lecturers coming from different backgrounds find these tutorials hard to run in a fruitful way, and regularly ask for guidance – see Section 2.7. We have no brief to promote this particular aspect of undergraduate teaching, but merely cite it as an example of the kind of site-specific practice where training may really be called for.

Sources: Chapter 3 of John Mason's book [23].

11. *Use of overheads, and/or lecture notes* How can a lecture be more than just the transfer of written information from text-book to blackboard and thence to students' lecture notes? Should lecturers hand out complete sets of lecture-notes at the start of a module, enabling students to pay attention, and allowing spontaneous deviation from the lecture plan, or does this encourage students to skip lectures? There are many questions and many answers; from the accounts of new lecturers discussed in Chapter 2.7 it is clear that this is a topic on which new lecturers want guidance. But a workshop on this topic need not preach a particular view. It is probably much more profitable to invite lecturers with a reputation for successful teaching to explain their own differing approaches.

Sources: Chapter 2 of [23], Chapter 10 of [4], Lecturer VI in XXX.

Other workshops run are listed below - see the website [1] for details.

1. *Teaching proof to mathematics students who have not met it before.*
2. *Directing undergraduate research projects*

We do not consider ourselves experts on all these topics. In some cases there are experts who can be brought in from outside - specialists in university-level Mathematics Education, for example, are usually very happy to be invited to speak to an audience (mathematicians) who they feel usually ignore

them - but in others we have found that meetings in which difficulties are raised and openly discussed by interested parties can be very enjoyable and therefore profitable, even without the presence of experts. We believe that simple engagement with the topic is just as valuable as having information or abstractly definable skills delivered to you by experts. Someone who is enthused and interested will go on to develop skills, and continue developing them, more effectively than someone who is subjected to a worthy but boring (perhaps because only partly relevant) training session. Moreover, although it may be true that salary structures are the strongest influence on the balance we set between teaching and research, we should not underestimate the importance of the esteem of our colleagues. Participating intelligently in a lively discussion on teaching can help us to hold our own in the sometimes uncomfortably competitive atmosphere of a research oriented department. The more opportunity there is for discussion of this kind, the more teaching will come to be valued alongside research.

Over the years Warwick Mathematics Institute has been running this kind of departmental training, the interests of the Coordinator have expanded, to include running events which are of general interest to staff in the department, because they address problems which concern every lecturer.

It seems that a training programme provides a natural platform from which to embark on this slightly wider project. Its training value comes through opening up the department's teaching to scrutiny and discussion which involves newcomers and old timers alike. Through this involvement, new staff are stimulated to contribute and integrate themselves into the department.

One final, simple point: if it's a workshop over in the university's staff training centre, of course no-one but the trainees will go. If it's in the Mathematics Department, there's a good chance of recruiting a wider audience.

Structure of the workshops

Workshops run by ISDs are often carefully structured to ensure active participation by all those present. After a plenary discussion, participants may be separated into small groups for further discussions and then asked to present the results of these discussions in another plenary, Although such detailed structure has some value, it runs the risk of alienating established staff by imposing too much control.

Partly for this reason, and partly because organisation of this kind re-

quires skills we did not feel we possessed, at Warwick we have left the structure of our meetings and workshops rather open. In some respects this is unsatisfactory - some new staff attend but do not participate actively. In order to promote more active participation by new staff, without alienating established staff, we ask new staff to write a brief report on the meetings and workshops they attend. This at least requires that they pay attention! New staff can be asked to post their reports on the training programme's website, as a means of informing others of what has taken place and the content of the discussion. This provides some incentive to thoroughness.

5.2.1 Setting and Marking Exercises and Exams

This is a rather contentious topic, especially in the research-intensive universities where most of the nation's strongest students are educated. So we take the opportunity to give our views before suggesting relevant training activities. We divide this topic into three parts.

1. *Setting homework questions*

We all agree that it is through *doing* mathematics that students learn. So we give them exercises to do. But how carefully do we think about what learning the exercises will bring about? How well do we judge their level and quantity? If they are not marked for credit, are the students actually doing the exercises? Are they being excited or depressed by the hard ones we put at the end? Perhaps most crucially, what mechanisms do we have to *find out* how well we are doing on these different fronts, so that our teaching can at least evolve in the right direction?

Setting exercises at the right variety of levels, ranging from enabling the weaker students to learn the basics to challenging the strongest students and stimulating their interest in the deeper aspects of the subject, is a skill we do not all enter the profession with. Most new lecturers are enthusiastic, sympathetic and approachable. But they have just come from a prolonged period of research, as PhD students and postdocs, in which their day-to-day experience of mathematics is about as far from that of a beginning undergraduate as it is possible to be. Helping them to recognise the needs and capacities of their students is vital for good teaching. We particularly recommend the books of John Mason, especially *Mathematics teaching practice: a guide for university and college lecturers*, [23], especially Chapter 4, *Constructing tasks*, and *Learning and Doing Mathematics*, [22]. More, it seems

to us, than any other author, Mason has thought carefully about what the qualities that an exercise can possess, and he writes about them in a way that is often exciting. Reading his books, one finds oneself making notes of some of his sample exercises, for use in a future class. He gives not just good exercises, but also insights into what makes an exercise good, or interesting, or educative in any of a surprising variety of different ways.

2. *Marking Homework*

Marking is time-consuming, repetitive and frustrating. When we have classes of 200 students, it becomes impossible to mark homework without a team of graduate TAs. It seriously conflicts with our research. But in our opinion it is irreplaceable as a means of learning, both for students *and for lecturers*. We don't mean simply assigning a mark ("summative assessment"), but also commenting, correcting and advising ("formative assessment"). Students can learn an enormous amount from this. They appreciate the personal attention that is involved. Even the simple assigning and recording of a grade is a significant stimulus, probably the most significant available, to studying outside lectures. Perhaps just as important is the fact that lecturers learn too, because by marking students' homework we can see what is being understood and what is not, and, sometimes, why. Such knowledge can be crucial in adjusting the aims and methods of our teaching to meet the needs and abilities of our students. Of course this is nothing more than the assertion that the scientific method has a role in teaching. We remind the reader of the quote from Lewis Elton on page 5, commenting on the irony of its absence in most matters relating to university teaching.

If we do not mark students' homework (and most of us do not), then at the heart of our practice as lecturers is the uncomfortable fact that we are far from doing the best job possible. Devising ways of encouraging students to do their homework without crippling our research activity is a major challenge. Departments with a good number of graduate students can pay them to mark homework. Everyone gains from this, since the graduate students can earn a useful additional income at the same time as strengthening their basic mathematics and learning about teaching. Nevertheless, this still leaves lecturers ignorant of what their students are achieving, until they mark the exam, when it is of course too late. One compromise that is worth exploring is for the lecturers of large courses is to mark a small sample themselves and leave the rest to the TAs.

The UK exam system is very different from those in countries from which

we recruit our lecturers – see the accounts of the experiences of foreign lecturers in XXX especially Lecturer VIII. Lecturers from the US are used to administering their own exams, and running mid-terms as well as final exams – which take place at the end of the module, and not in an exam period at the end of the year. Lecturers from Central and Eastern Europe are used to oral exams. The lesser degree of formality associated to such practices increases the formative aspect of the assessment. This is evident in the case of oral exams, but it is true even in the case of written exams, provided the lecturer is free to show students their scripts if he or she wishes. In the UK the level of formality has steadily increased. Among the reasons are

- the enforced anonymity of scripts, in the interest of fairness;
- the prohibition on discussing marks until the exam board has taken place, which generally postpones any discussion until the following term;
- the increasing unwillingness on the part of university authorities to allow students to see their scripts, for fear of legal action;
- the requirement for double marking, again in the interests of fairness. If the second marker is not to be prejudiced, the first marker must not write comments *in situ*; writing them elsewhere requires another level of organisation, and is therefore yet another disincentive.

These factors have together greatly reduced the formative aspects of exams. It is particularly unfortunate that this should be so at a time when the increase in class sizes dues to the concentration of students in large, successful departments has led to a significant decrease in the amount of formative marking.

The limitations on the information reaching a lecturer because of the very small amount of marking that takes place can affect the quality of their teaching. Only somewhat exceptional events can convey the seriousness of this habitual state of affairs. Recently one of us has supervised some beginning PhD students as they undergo their first serious exposure to the subject-matter of a standard module he has been teaching for some years to final year undergraduates. Discussing the ideas and difficulties individually with these students has brought to light a number of points that had not emerged in several years of teaching a class of between thirty and forty.

Among other things, it has led to a much more vivid recollection of his own experience, and difficulties, in learning the same subject, and a concomitant recognition that in general he has not been allowing the students in his modules enough time to work their way through these difficulties.

In the light of all this, what kind of events should a department put on to train new staff in marking?

The first requirement is to make staff aware of the issues. Even the distinction between summative and formative marking may be new, and helpful, to some of those involved. There may be no solution to the problem of the essentially conflicting interests of students as learners and staff as researchers, but putting staff in possession of the facts will enable them to make a more reasoned decision as to where the line of compromise is to be drawn. Current arrangements in most departments enable lecturers to live in happy ignorance not only of their students's needs, achievements and abilities, but also of the very possibility that things could be otherwise. Opening their eyes to what could be achieved can also open up an area of creative endeavour for staff.

Rather than laying down the law on how things should be done, a workshop should aim to open the flow of information. Some of our diatribe here could form a part of this. A second purpose of any workshop, of course, is to train staff in the techniques of marking and assessment in general. A number of people have written cogently on the subject – we cite in particular Chapters 4 and 5 of John Mason's *Mathematics Teaching Practice*, [23].

See also the item on Computer based assessment and drilling below for one possible replacement for marking.

3. *Setting and marking exams*

Exam marks are extremely important to students, and so there is little room for lecturers to learn by trial and error. Moreover since exam marks are one of the few pieces of hard data with which to judge the success or failure of a module, new lecturers themselves can be traumatised by marks whose mean or variance deviate significantly from what is expected. Module mentors (cf Section 4.1) should check their mentees' exam papers for accuracy and level, and a great deal of the new lecturer's necessary learning can take place in the process of responding to their mentor's comments. It is very important that the module mentor ensure that the new lecturer's exam is set at an appropriate level of difficulty.

Because it can be painful², the period immediately after marking the final exam can be the most productive for a new lecturer to reflect on their module. If a review of their teaching is called for in the training programme, now can be the time to write it - though of course this may conflict with the lecturer's need to rush off to a conference as soon as the term is over.

Points to raise in a workshop:

1. What are the department's conventions and expectations e.g. where are the pass/fail and class borderlines and what should the average mark be?
2. Different parts of a question can detect different levels of learning, skill and understanding. Some departments like each question to give students the opportunity to display their book-learning, and, perhaps, to scrape a pass on that basis. They may also want each question to end with a part calling for more fluent and creative use of the material. Marks for the different parts of the question should be assigned according to the desired outcome: the more marks are assigned to the final hard part of the question, the wider the spread will be.
3. Think about the range of possible answers, and decide how many marks each would score. If it is not sufficiently clear what the question is asking for, you may end up having to give full marks to an answer that does not display the qualities you wanted to elicit. Or find yourself having to decide whether to award marks to a correct proof of something you wanted the students to use without proof.
4. If you have to mark three hundred scripts, an unfortunately designed question can cost you a significant amount of extra work, by offering students the possibility of making too many different mistakes. Avoid having to check through three hundred essentially different calculations!
5. An exam is not ready until the examiner has written out a set of model solutions. Only then will it be possible to be sure that the questions are correct and of suitable length and level of difficulty.

²See the account of Lecturer III in XXX

6. Students should be encouraged by the exam to perform at their best. An easy opening part of a question may be correctly answered by everyone, and thus achieve nothing as far as distinguishing one student from another is concerned. But it can play a useful role in putting less confident students at their ease.
7. For similar reasons, the level of difficulty in each question should be monotone non-decreasing.
8. This year's exam affects the study strategies of next year's students. If students see that the exam contains some homework questions, they will do the homework.

Sources: Krantz [17, Chapter 2 Section 10].

Chapter 6

Writing and Reflecting

6.1 Reflective Essays and Reports

In this guide we distinguish between *essays* and *projects*. By the former we mean pieces of writing that are essentially reflective, requiring of the writer an assessment of some aspect of their own performance or experience, though quite possibly informed by the study of other sources. By the latter, we mean a piece of work that requires some non-bibliographic research - for example, finding out about employment destinations among the department's graduates, or making a study of some aspect of the department or university's provision.

Both types of written work are of intrinsic value in several respects, and both provide evidence for the purposes of assessment.

Recently there have been a number of initiatives aimed at getting students to improve their understanding of areas of mathematics by writing about them. Writing on a topic, reformulating the ideas in one's own words and organising their presentation is an effective way of developing deep understanding in an area. One would make a similar argument for writing about one's teaching. Yet essays set in many generic ISD courses are often resented by new staff and such things as writing up teaching observation reports are sometimes regarded as the least useful part of the process (see the comment reported in Section 4.2). We think the main reason for this resentment of generic essay writing is that it is often an artificially manufactured device to provide an object of assessment - it serves little purpose otherwise. The answer to this is to ensure that all reflective writing and reporting is related

directly and constructively to the lecturer's day to day teaching activities.

As noted above essays are among the most unpopular parts of most training programmes, not only among mathematicians. However, mathematicians seem particularly averse to essay-writing. We are accustomed to a high level of rigour and precision in our own professional writing, and critical of the standards of argument in other subjects. The kind of reflection encountered in some reflective essays can strike us as uselessly vague.

So is there any place for the essay in the training of new mathematics lecturers? Here are some arguments in favour:

1. Essays still form the core of what students do in most humanities subjects:

Writing essays...is an essential step in promoting intellectual development, internalizing knowledge and developing the capacity for rational thought. These objectives...are the most important rationale of universities...There is still no better way of fostering intellectual development in many subjects than requiring students to produce...essays.

to quote Patrick Dunleavy, a political scientist at LSE, in [8]. Once again, a Google search throws up a wide range of resources on the virtue of essay-writing.

2. The body accrediting the training - the university's ISD or the Higher Education Academy itself - must be provided with evidence not only that the trainee has met the demands of the programme but that the programme itself is worthy of accreditation. A written document such as an essay can provide such evidence.
3. Employers regularly complain about the inability of maths graduates to write reports, and in response to this many maths degrees increasingly require students to write essays. We should be prepared to do so too, especially if we are likely to be required to mark our students' essays.

Here are some examples of reflective essay topics:

1. End of session module reports, including an exam report written after the marks have come in. When one has just finished marking the exam, one is most acutely aware of the successes and failures of the course,

and of the areas where teaching must be strengthened or objectives reined in.

2. A comparative essay on some reading on pedagogical issues, relevant to the writer's teaching.
3. Description of preparation for a recent lecture course.
4. Description of how the lecturer learnt this subject that they now teach (we suspect that in some cases we took more time than we are now prepared to allow our students!).
5. An essay on the new lecturer's recent experience in learning, with a view to relating this to student experience. ¹
6. A design for and report on a tutorial.
7. Pieces on teaching techniques you have published e.g. in *Connections*, the newsletter of the MSOR Subject Centre.

6.2 Projects

A significant part of the training may take the form of a project. As a rule, projects should aim to be genuinely relevant to teaching. They should never be exercises undertaken merely to fill a formal requirement. New staff are liable to be upset by the regressive aspect of being "trained"; accustomed to being respected as significant members of a research community, they may be irritated at having to produce written work with no real audience. In one sense good topics are all too easy to find: the coordinator and the new lecturer need do no more than find some area of the department's teaching, or the students' learning, that is less than optimal, and set out to find causes and remedies. But there is no reason to look only at failures; studying the

¹One reason research activity can contribute to teaching is that an active researcher is necessarily an active learner. Research-oriented learning takes place at a different level from undergraduate learning, and with different objectives, but the two still have a lot in common. Researchers, like students at any level, are trying to master new and challenging ideas and techniques. Some attempts are more successful than others. What makes the difference? Understanding this of your own learning helps you to understand the difficulties of others.

organisation and structure of a particularly successful course might make a useful project for a beginning lecturer.

A very useful positive aspect to projects is that for foreign lecturers or those from industry they give staff with experience of other educational practice the opportunity of integrating the fruits of this experience into the UK setting. This can be beneficial for all concerned.

The following projects have been carried out by new staff on the Warwick training programme:

1. A study of the effectiveness of a new approach to teaching Analysis
2. Fixing a syllabus and typing lecture notes for a core course which had lost its way.
3. Designing a module on Euclidean Geometry
4. Investigating the feasibility of using oral exams in place of written exams for high-level mathematics courses.
5. Integrating the internet into teaching using Wiki software.

The project on oral exams, in particular, is likely to be made use of in the near future.

Examples of other questions that could be investigated in a project include:

1. How can we motivate bright students to go for more than just high marks? Would a US-style Honours Programme work in the UK?
2. Do other comparable departments teach to a markedly different syllabus from us? How do they differ, and should we follow their example?
3. Do partial exams mid-way through a module promote better learning?
4. How does being at the bottom of the heap affect student learning in mathematics? Would our bottom students learn more on a less demanding degree course? How could we persuade them to transfer?
5. What are the employment destinations among the department's graduates? What uses do they make of their mathematics training?

6. Where are the boundaries between plagiarism and group-work in assessed assignments? What can be done to avoid the former and promote the latter?
7. How useful are voluntary support classes? What are the alternatives, given the size of the student cohort?

Projects of this kind are the opportunity for real scholarship on teaching and teaching-related issues, and can encourage the lecturer to invest intellectual energy which is often confined to research.

At a more practical level, a participant could

1. Use one of the CAA packages such as *AIM*² or *Stack*³ to produce electronic drilling or assessment for a course they are teaching, or in preparation for such a course;
2. Devise a computational segment for a standard course taught in the department;
3. Prepare a web-based tutorial on a problematic topic from the undergraduate curriculum;
4. Liaise with a researcher in university mathematics education to assess the effectiveness of some aspect of the department's teaching

The point is that in any department there exist many possible issues of real importance, so there is no point in wasting time on manufactured problems designed simply for assessment purposes. Nominally a project in a PG Cert may take anything up to 300 hours. It is ludicrous to for the new lecturer to expend this time producing something for the examiner's eyes only.

²web.mat.bham.ac.uk/C.J.Sangwin/aim/index.html

³<http://stack.bham.ac.uk/stack/>

Chapter 7

Training and quality assurance

7.1 Quality assurance versus staff development

Of course, any institution will have quality assurance procedures and will rightly wish to ensure that new staff are prepared for their duties to a level that meets the various quality requirements. Normally this is covered under the arrangements for such training and through such things as appraisal. So, as we have noted elsewhere, the individual's training will need to be linked to quality requirements, usually through the ISD. Normally this will be a formality, and easily accommodated. There are instances where further thought may be needed however, and in this chapter we consider three such examples.

7.2 Cultural issues for foreign lecturers

Recently there has been an influx of foreign lecturers into UK Higher Education, particularly in Mathematics. In at least one UK mathematics department the ratio of non-UK to UK academic staff is 5:1. Now there are positive sides to this. Staff from other countries bring a wealth of varied experience and a wide range of ideas into the UK system. And indeed we have already bemoaned the fact that few generic ISDs have mechanisms for capitalizing on this. It is something that maths departments can tap if they are alert to the possibilities. On the other and it has to be admitted that this influx of

foreign lecturers brings with it certain problems, which departments must be alert to.

The first is the standard of English spoken by the lecturer. Sometimes even the new lecturers' colleagues have problems understanding them. For the students it is likely to be even more difficult. This issue is taken very seriously by one of the respondents to our survey of how experienced lecturers learnt to teach maths (book website), worth quoting in full:

English is not my mother tongue, and I wish to say a few words to fellow sufferers who, like me, are forced to strain their voice cords by giving lectures in a foreign tongue to audiences of up to 200 students.

I came to Britain already having had some serious teaching experience. It was obvious for me that I had to take special care of quality of my English and I sought advice from a professional teacher of English. She videotaped one of my lectures (strongly recommend!) and helped me to identify two key issues: articulation and projection of voice.

These are interesting points. Many mathematicians frequently “talk to the blackboard”, forced to combine talking with writing long formulae on the blackboard. I always liked to look at the audience, but here it became clear that I had to entirely exclude even occasional “talking to blackboard”. My English was sufficiently blurred by a different pattern of articulation of my mother tongue, so to hide my lips from students meant to further impair communication. I took the advice very seriously and soon realised that the best way to separate writing on the blackboard from speaking was to follow simple rules:

1. I try not to speak when I am writing.
2. When I have to say something, I stop writing and press the chalk against the board immediately at the end of a phrase or a formula, so that later I am able continue my writing exactly from the point where I stopped.
3. Then I turn to the audience – keeping right hand with chalk in it on the board (I am right-handed).
4. I use this movement to free my diaphragm and rib cage and fill my lungs with air – the outstretched arm helps me to take in a proper breath.
5. Then I speak, looking at the audience, making eye contact and projecting my voice into the lecture theater. (A side remark:

calm relaxed breathing means confident speech. In a large lecture theater, students' independence is suppressed by crowd dynamics, and they are much more receptive to non-verbal and subconscious clues in communication. Good breathing technique is the first step to mastering crowd control. By the way, the chalk pressed against the blackboard at the end of unfinished line perhaps plays the same role as a watch on a chain or a wand in hands of a stage magician – it works as a focus of the audience's attention and emphasises that the lecturer remains in control.)

I believe that over almost two decades of my work in Britain I delivered some decent lectures, but I felt that my voice cords were under constant strain. This is why I arranged a session with a professional voice coach. It took her less than a minute to diagnose the problem. She asked me to pretend standing at a blackboard and say, as I usually do in the lectures, a few opening words – in English and then the same phrase in my native tongue. The problem was obvious in English I was speaking in unnaturally low voice, much lower than I normally speak in my native language. This puts a strain on voice cords. Some exercises recommended by the coach (and even more so - a simple awareness of the problem) helped.

Therefore my advice to my colleagues (especially non-British ones):

1. Even if you feel that your lecture technique is OK, propose to the Staff Development Office that they do something useful instead of their usual Powerpoint training and request them to arrange a one-to-one session with a professional voice coach.
2. You may find that it is best to avoid whiteboards – felt pens are made for writing by hand and wrist; small movements of fingers and hand suppress breathing. When writing with chalk on a blackboard, we move the whole arm, which assists the proper ventilation of lungs. The worst thing that you can do is to write on a transparent film directly on the plate of an overhead projector – it is very difficult to avoid reducing your voice to a whisper.
3. Try to videotape and watch your lectures (but be prepared for a shock!).
4. Teaching is not a science, it is art. Moreover, it is a performance art. Some lessons of theatrical acting (basic stuff – posture, voice, stage movement) would really help.

This may become an important issue for the department and may require significant input from the mentor and any relevant university services. But the problems may go deeper than simply language difficulties. Other countries have different cultures and attitudes towards students and since most foreign recruits will come from top institutions with very high standards and possibly very elitist attitudes, these may not translate well to the UK environment. In UK universities we have a very supportive culture towards students, particularly since the drive towards widening participation has dramatically broadened the intake background. On the other hand in many elite Russian institutions for example any problems the students have are regarded as just that - their problem. This Darwinian approach may be fine at creaming off the very top students, but it is simply a waste of resources in a system where students across the whole range of abilities are entitled to a good education that helps them realize their full potential.

Also, during their undergraduate studies some foreign students will have been in the company of highly competitive and motivated fellow students who will have shared their obsession with maths. They therefore tend to expect too much of their UK students who merely see maths as a job ticket and rightly expect a good education to fit them for that purpose. Like all new lecturers, foreign recruits have to realise that most students might not be like them, but are still entitled to a proper education.

7.3 What to do about poor teaching

There may be occasions on which issues of lecturing quality transcend the bounds of training. Poor teaching by a new lecturer is primarily a problem for the students. A departmentally-based training programme is much better placed to respond to a problem of this sort than a generic programme. Here is a description from an article ([25]) one of us published in the MSOR Subject Centre journal *Connections*. Although couched in hypothetical terms, it is based on real experience.

Let us imagine ... what would happen if a new lecturer had serious problems with his teaching. As currently envisaged, the system would work like this:

1. The first module mentor observes a lecture. He realises that some serious changes to the style or content are needed, and

makes recommendations to the participant accordingly, both in person and in writing. At this point a lot depends on the two individuals involved. A serious participant will make efforts to improve his teaching in the light of the recommendations, or, possibly, will consult with the coordinator if he feels that they are inappropriate or mistaken. A concerned mentor will decide to visit the lecture again, to see if his recommendations have had any effect on the participant's teaching. Let us give both the benefit of the doubt and assume that they take this course of action.

2. Aware of the difficulties, the participant himself alerts his second module mentor, and arranges to have his second courses lectures visited early in the term, in order to catch the problems early on.
3. The module mentor attends an early lecture, makes suggestions, and attends further lectures. If the problems are sufficiently serious, and the participant's teaching does not improve to an acceptable level in response to the mentors suggestions, the mentor will alert the coordinator.
4. The department now has to decide how to confront these problems. Because they concern students as well as the trainee, they transcend the framework of the training. Different departments will respond to such situations in different ways. It may well be that it is possible to devise further training within the department, or to buy in specialised services, from the university's ISD, from the MSOR Subject Centre, or from further afield.

In any case, the system of mentoring provides a means of detecting problems with teaching at an early stage, and at least some of the means to tackle them.

In the case which motivated this description, the lecturer went through a second cycle of lectures, with new mentors. This was prefaced by a meeting bringing the lecturer together with the Coordinator and the old and new mentors. His teaching improved significantly the second time around, as reported both by the mentor and by student course evaluations, and he successfully completed the training.

Problems in teaching of the kind described are often picked up by students before the department becomes aware of them, and it is important that

the department is seen to respond effectively and in the interests of students. For this reason, there should be good links and liaison between the Coordinator and the Staff-Student Liaison Committee, the department's Teaching Committee, and other quality assurance mechanisms.

If there are problems in the teaching of an individual that cannot be addressed by the department - for example the need for voice training or other communication skills - the Coordinator should be able to locate appropriate support either in the university's ISD or further afield.

The department should try, as far as possible, to integrate its staff development programme with existing quality-assurance mechanisms such as peer observation, exam moderation and checking, etc. Wherever possible, time spent in these mechanisms should be counted as part of the training. This will save duplication of effort by the participant and by course mentors. Although this is a trivial point, it is worth making sure that, for example, clerical staff in charge of assigning exam checkers and peer observers as part of the department's normal quality control should make sure this task falls to the appropriate module mentors, in the case of new staff who are taking the training programme.

As a final point on the theme of quality assurance, we raise the possibility that a Coordinator who has successfully overseen the training of his or her new colleagues may be able to play a role in helping other lecturers to improve their teaching, perhaps in conjunction with specialists from the ISD. We are wary of asking anyone to take on the teaching of *all* of their colleagues; but many departments have one or two lecturers whose teaching is manifestly poor, and although collegiality might urge us to leave well alone, ignoring poor teaching is unfair on students and can damage relations with the student body. A training coordinator who has gained experience and authority is well-placed to deal with this kind of problem. Once again, we see the transfer of some training responsibilities to the department as potentially contributing in new ways to the wider teaching effort.

7.4 Recognising and accrediting previous experience

All training programmes must have a procedure for recognising previous experience and training, and granting exemption from some or all of the

training on that basis. The procedure should be simple and quick. However, even experienced new staff should still attend events concerned with site-specific issues - for example how the tutorial system works, or, especially for staff from abroad, the level and content of A-level mathematics.

One of the complaints about generic provision is that it fails to take into account the differing levels of previous experience that are typical of new permanent staff in different subjects. Mathematicians generally spend several years between completing a PhD and getting a permanent position; this is longer than most new staff in, for example, humanities subjects, where far fewer post-doctoral appointments are available. It is important, for this reason, that at least one member of the mathematics department - most likely the Coordinator - should be involved in any decision about full or partial exemption. Their understanding of the background of the new lecturer reduces the need for the copious documentation which sometimes makes obtaining exemption nearly as onerous as taking the training.

Chapter 8

Resources

8.1 Existing staff

The most important resource for the departmental component of training is the existing staff. Their skills, knowledge and willingness to help are what will make the greatest contribution, beyond a trainee's own efforts, to improving his teaching. This book has been written with the assumption that the department has a teaching culture it is proud of and wishes to transmit to new staff.

There is a danger, of course, that reliance on existing teaching culture will foster conservatism and resistance to new ideas. In many British universities this danger is to a large extent neutralised by the enormous influx of new ideas and approaches to teaching that arrive with foreign trained lecturers, who often make up the majority of new appointments. We believe strongly that new staff should be encouraged to contribute their ideas to departmental teaching culture, and given the opportunity, as part of their training, to propose changes to existing practice in the light of these ideas. New ideas from outside will enrich our teaching, as they have done in practically every sphere of cultural activity.¹

In a department which needs to develop new approaches, help could be sought from the MSOR Subject Centre in Birmingham, or by sending new staff to investigate how things are done in other universities, not necessarily in the UK.

¹We are more sceptical about managerialist ideas that may originate in sectors of society which feel little sympathy with the aims and ethos of university education.

8.2 Books and journals

Books and journals should be made available in the departmental or central library. There are several excellent books on the teaching of mathematics in universities. We recommend [2], [12], [15], [16]. [17], [22] [23],

Steven Krantz's book [17] is a cogent exposition of a fairly traditional view of mathematics teaching, enlivened by a collection of essays by other authors, some of which dissent radically from Krantz's view. Steve Zucker's is one of the less dissenting essays, but one of the most interesting. Zucker focusses on the need to get students *studying*, and argues that in some respects "less is more". If the lecturer's brilliant explanations remove the need for the students to work at understanding, then at the deepest level perhaps they are hindering their education. This is a hard area in which to navigate: "less is more" can be an excuse for laziness and can lead to loss of contact between lecturer and student. Do profound and insightful lectures really prevent students from thinking for themselves? Perhaps in keeping with the philosophy he is advocating, Zucker does not provide all the answers, but certainly succeeds in provoking thought.

One of the striking features of Krantz's book, and, it seems, of other books on teaching written by US mathematicians, is the extent to which in the US, service calculus modules dominate the horizons of mathematicians interested in education. Because US university students don't choose their major until their second year, huge numbers of less-than-committed students are obliged to take calculus modules, taught to them by lecturers and TAs from the Mathematics Department. The attitudes and aptitudes of these students provide the backdrop to a great deal of the discussion, no doubt because this is where most lecturers begin their teaching careers. Perhaps as a consequence, there is little feeling of fellowship or shared aspirations with students, though Krantz shows a great deal of concern and respect. And there is very little discussion of the transmission of higher-level mathematical skills and inspiration, of the kind that one might hope would take place with the strongest students. Although such students may appear to be the least problematic, encouraging them to develop their abilities to the maximum is of crucial importance for the future of the discipline, and, perhaps, is just as much of a social good as saving a struggling student from failure. Every student, whatever their level, should have equal opportunity to develop their full potential.

The narratives of students struggling with the difficulties of learning

mathematics are sympathetically and insightfully studied by Yvette Solomon in [31].

John Mason's book *Learning and doing Mathematics*, [22] provides material for the kind of problem-solving module which would be a delight to teach, but is generally squeezed out of university mathematics curricula by the pressing need to cover a traditional syllabus.

The essays by Matt Owens ([27] and [28]) offers a salutary comparison of student behaviour in examples classes and in lectures. The paper [36] of Yusof and Tall, cited by Matt Owens, examines the changes in students' attitudes towards their own mathematical activity resulting from a course devoted to problem-solving, along the lines advocated by Mason in [22] and by Mason, Burton and Stacey in [23]. Tellingly, a second paper, [37], documents the return of a more passive attitude once more traditional teaching is resumed.

The MSOR Subject Centre is currently building up materials, web and print-based, that will support training. See [6]

Copies of recent A-level Mathematics papers are very useful and should be regularly renewed. Once again, the annual process of doing this should be put in the hands of clerical staff. Another useful guide to the sorts of things covered at school level is [24], although what this booklet gives is a very optimistic list and even a good A-level student will only have a sketchy grasp of a small subset of the material.

A recent short book, [2], by Lara Alcock and Adrian Simpson presents an accessible introduction to ideas from Mathematics Education, aimed at mathematicians.

Completed essays, portfolio material, and work of previous participants could be posted on the departmental website, along with stationery, teaching observation forms, etc.

A list of other resources can be found on the Warwick Training Programme website [32].

8.3 The website

A departmentally based training programme should have its own page on the department's website, and it should be a recognised and budgeted part of the Coordinator's role to maintain the website. It is important for many reasons:

1. It should contain a detailed explanation of the structure and requirements of the training programme, sufficient for new staff to find their way around in it without having to chase the coordinator. With the onus on new staff to find things out for themselves, the Coordinator's load, and reasons for worry, are reduced. The programme can then, to some extent, run itself.
2. It provides a resource for people taking the training. It should contain links to the MSOR Subject Centre, to suitable web-based literature on teaching and learning issues, as well as stationery (teaching observation forms, etc) needed by participants. It should also contain a list of suggested projects, each with a brief rationale. All staff should be invited to contribute to the list.
3. It provides a resource for module mentors, both actual and potential.
4. It is a natural place to publish projects and essays produced during the training. There is an argument for making this a requirement, especially of the project. Publication in this way gives essays and projects at least a notional audience, and may help to reduce the feeling that writing them is a regression to an earlier stage, left behind with the start of professional life, where one wrote only for the marker to read. It is also an admirable stimulus to quality!
5. It provides a platform for advertising workshops and seminars.
6. It provides a resource for other members of the department not involved in the training, including students. They may want to find out what was said at the Learning and Teaching Forum, or learn about forthcoming workshops.

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