What Sort of ‘Teacher Training’ do Mathematics Lecturers Want?

Teaching in UK higher education has increased in status and profile in recent years, and there is now often an expectation that new lecturers undergo some kind of ‘teacher training’ - possibly accredited. As described in [1], there is already a distance learning Certificate in Teaching Statistics - now in its second year of operation, supported by the Maths, Stats & OR (MSOR) Network in the Higher Education Academy (HE Academy), and the Royal Statistical Society (RSS) Centre for Statistics Education. This has been accredited by the HE Academy as a 20-credit programme that new lecturers can use towards HE Academy membership. Also, for some years an annual residential induction course for new teachers of mathematics in UK higher education has been run at Birmingham, under the auspices of the MSOR Network. At the moment this is not accredited, but the Network is working with the professional bodies, learned societies and a number of mathematics departments to develop an accredited training programme for HE mathematics teachers, similar to the statistics offering. So it is timely to pose the question of what sort of training provision would the MSOR community like to see for those undertaking the teaching of mathematics in HE institutions? Of course, there will be many (sometimes contradictory) responses to this. In this article the current context is described, and some of the emerging issues considered.

Sources of teacher training in HE mathematics

The normal requirement for a postgraduate teaching certificate in HE institutions is 60 M-level credits, amounting to a nominal “student-lecturer workload” of about 600 hours. Working on this basis, what might be a suitable programme for the new lecturer? Currently, a new (or old) mathematics lecturer has access to a range of sources:

- In-house training courses provided by their institutional staff development units – these are usually generic, undertaken with a number of lecturers from other disciplines
- On the job training/apprenticeship from colleagues within their department – this can sometimes be formalised by some kind of mentoring arrangement, often working with the central staff development unit, with the lecturer benefiting from both discipline-based and generic input
- External staff development courses mounted by such bodies as the HE Academy – these are usually generic, and relatively focused, a major benefit being interaction with others from across the HE sector and across the disciplines
- Attendance at teaching or mathematics education conferences such as the Undergraduate Mathematics Teaching Conference (UMTC) – these can expose the new lecturer to a wide range of experience in mathematics teaching in HE
- There are now a number of easily available books, journals and other publications on the teaching of mathematics in HE, [2-6] being a by no means exhaustive list of titles, and two useful journals being Teaching Mathematics and its Applications and IJMEST – and of course MSOR Connections
- The MSOR Network Induction Course for New Mathematics Lecturers – a two-day residential course providing talks from experienced practitioners in HE teaching, and the opportunity for interacting and...
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commiserating with colleagues from mathematics departments across the UK
• For statisticians there is the HE Academy accredited Statistics Teaching Certificate, available on a distance-learning basis from the RSS Centre for Statistical Education. (See http://science.ntu.ac.uk/rsscse/activities/programme2.htm) The Certificate is funded by the HE Academy MSOR Network, was developed by the RSS Centre for Statistical Education and is accredited by the RSS.

The above describes a rich mix of input to the training of HE mathematics lecturers. It has however evolved in a somewhat ad hoc manner in response to the many government and funding council initiatives assailing HE in the last couple of decades. During this evolution there has actually been little opportunity for input from the grass-roots mathematics practitioner in HE. With the advent of the HE Academy, and the continuing growth in activities and influence of the MSOR Subject Centre, this will change. The Network has the resources and facilities to canvas opinion across the MSOR sector, through its network of departmental representatives, and to disseminate information and practice through its publications and the annual conference currently being arranged in association with UMTC.

For example, many books on teaching are idiosyncratic, and often present the accumulated experience of one person. Valuable though this might be, it is basically anecdotal evidence in a subject that is notoriously lacking in evidence-based practice. The emergence of the MSOR Subject Centre and the HE Academy now provides an unprecedented opportunity to go much further than this. It has access to and can draw on the expertise and experience of practitioners from across the MSOR sector, through its network of departmental representatives, and to disseminate information and practice through its publications and the annual conference currently being arranged in association with UMTC.

With the help of MSOR practitioners it is now possible to obtain a sector wide view of the issues facing the modern HE mathematics teacher, and their aspirations for the future of their profession. The Network has set up a working group to steer production of an accredited induction programme and materials for new mathematics lecturers, with representatives from the London Mathematical Society (LMS), the Institute of Mathematics and its Applications (IMA), and the Heads of Departments of Mathematical Sciences (HoDoMS). This group would be greatly helped in its work by input from as many HE mathematics teachers as possible, and if this interests you please send your ideas as possible, and if this interests you please send your ideas to either me (w.cox@aston.ac.uk) or Joe Kyle (j.kyle@bham.ac.uk). To promote debate let us now look at some of the issues that might arise by taking stock of where we are and what we might do starting with a blank sheet of paper. We might as well focus on the training needs of the new lecturer, since middle-career developmental needs/provision will be built on that.

**The basic principles of teacher training in HE mathematics**

Training for mathematics teachers in HE would seek to develop

1. basic knowledge and skills of curriculum design, delivery methods, and assessment
2. practical skills in managing the teaching process, supporting students’ learning and conducting assessment
3. deeper understanding of the underlying principles and theories of teaching and learning
4. attitudes, self-awareness and self-development in relation to the teaching and learning process and interaction with students

all as they bear on mathematics teaching.

All of the sources listed in the previous section can have useful input into these areas, whether at the generic or discipline-based level, but most tend to focus on 1 and 2, with 3 and 4 occurring accidentally, if at all. This is a consequence of the way in which teacher training has evolved in HE – reactively and in a minimalist manner, designed to help the new lecturer cope with their first teaching duties. But, if we are starting with a blank sheet and seeking to develop the best possible teacher training, wouldn’t 3 and 4 also be high on the agenda? Viewing teaching as communication, 1 and 2 may be regarded essentially as use of the media for teaching and learning (including the lecturer themselves). This is perhaps where the mathematics community can have the greatest input, and where the process of teacher training becomes most interesting and challenging.

**Issues to consider in HE mathematics teacher training**

Let us assume that the routine generic aspects of
teaching and learning have been taken care of. What are the really crucial issues about teaching mathematics that we would want the novice lecturer to think about? Some suggestions follow, in the hope that they may spark off other ideas that you can pass on to us. They are in no particular order; they just seem to be distinctive features of mathematics teaching that a generic teaching course might not pick up. Some experienced lecturers might regard them as issues that are still unresolved and merit deep investigation if mathematics teaching in HE is to be put on a rigorous foundation. Most of the issues can be stripped of their mathematical context and presented as useful generic principles for teaching any subject, but would lose a lot of their impact in doing so. Set in a mathematical context, via mathematical examples and ideas they are easier for the new mathematics lecturer to appreciate.

- Mathematics is designed precisely to be the most efficient and universal language and because of this there are few other subjects that can lose students so quickly. One of the first things for the new lecturer to learn is how to accurately assess the command of the language that the bulk of your students have and the level of ‘pigeon mathematics’ required to carry them with you.

- In teaching mathematics we can often teach two things at once – ‘doing and undoing’, and the undoing is often harder than the doing and relies crucially on how good you are at the doing! For example algebraic multiplication and factorization, common denominator and partial fractions, differentiation and integration. The novice lecturer may benefit from having such linkages pointed out.

- Well intended regular drill practice can sometimes conceal important conceptual hurdles. For example we can give plenty of practice in solving eigenvalue problems either computationally or manually, and this may give the impression that the students really understand the eigenvalue problem. Yet by simply asking them to verify given eigenvectors we provide a much easier practical problem, but one that requires more understanding of the principles involved. That giving part of the answer can be useful in developing conceptual understanding is not always obvious, particularly for the novice lecturer.

- We often teach too much too superficially rather than less more thoroughly. The new lecturer particularly needs to develop the skills of identifying the key basic results in a topic and then ensuring that these are thoroughly taught.

- Students’ solutions to problems, as presented in coursework for example, are often simply a list of equations, with little or no explanation of what they are doing. Sometimes they are in fact imitating what we might do in our presentations. Although we may explain the steps verbally as we go, what actually appears in most students’ notes is simply a list of equations, copied from the board – and this is how they get used to presenting their solutions.

- We are often told that students learn best in an environment of ‘frequent feedback’. This may not be the case in mathematics, for some teachers interpret this as the need to provide frequent summative coursework. However, if there is too much of it the students will only do the work that they are told to do, and will get used to receiving feedback only from an expert. In order that they gain practice in independent learning skills it may be better to provide less summative coursework, but more formative work.

- Mathematics is one of the largest service subjects and a large proportion of the work of mathematics lecturers is teaching to other disciplines. How do we get across to the new lecturer the peculiar problems and challenges of service teaching?

- To the novice the relative difficulties of teaching hard advanced mathematics against teaching elementary material are not always clear. Of course, teaching ‘hard’ mathematics isn’t necessarily hard and teaching ‘easy’ mathematics isn’t necessarily easy. Yet sometimes new lecturers are given first year classes on the assumption that this is the easiest teaching. The crux here is to train the lecturers to recognise what is difficult to teach rather than what is difficult mathematics.

- The new lecturer may not appreciate the distinction between teaching a proof and teaching how to prove. Every experienced teacher knows how easy it is to teach proofs to students as opposed to teaching them to effect proof themselves. The new lecturer might benefit from training in the latter skill.

Some generic issues

In addition to mathematics specific issues such as those noted above, there are also a number of generic issues to think about, some examples given below.

- How much should we expose new lecturers to ‘theories of learning’? No lecturer, particularly these days, has the time to examine critically all
theories of learning on the market, evaluate them and embed them in their everyday practice. So we have to find a balance in training the new lecturer. It would seem to be a minimal requirement that they are exposed to the main widely accepted theories, that they are aware of controversial issues, that they are encouraged to think about what these might mean for their teaching, and to formulate rationales for the way they teach.

- How do we assess the teacher training? As we insist for assessing students, assessment must be valid and reliable, matched to the learning objectives and the ‘student’ profile, and must be practical. The fashion these days is to use ‘portfolios’, comprising evidence of work done. But there is a role for a range of assessments to meet varied objectives. One could have projects and assignments for example. Schoolteacher training might provide a model here.

References