
The MMG HE Curriculum Team – Neil Challis, Mike Robinson and Mike Thomlinson

More Maths Grads Project – the HE Curriculum theme

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One of the quieter aspects of the More Maths Grads project (<http://www.moremathsgrads.org.uk/home.cfm>) to date is the so-called HE Curriculum theme. Actually this is a slight misnomer. The theme is only partly concerned with curriculum content per se, although some issues are arising in that respect. It is as much about understanding and improving the kind of experience we provide for our students of Mathematics, how we teach them, engage them and support them, how they feel about that experience, and what the implications are of all that.

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The rationale is this: the project workers are working hard, both with potential students and with employers, to generate more interest in and enthusiasm for Mathematics, and therefore more applicants perhaps from a wider base, and thus more graduates. It therefore behoves us to understand and share what is good about the courses into which the beneficiaries of this push for more maths grads will be walking.

So one of our major activities over the past year has been to explore and review the way courses are working in the four institutions directly involved in the project (Coventry, Leeds, Queen Mary, and ourselves Sheffield Hallam). We have run large scale questionnaires, focus groups and individual interviews, with first year students, postgraduate tutors, and lecturers.

We are at the stage of talking about our findings now, and as part of that process, we offer two other articles in this issue of *MSOR Connections*, one on *Student Support* and one on *Lectures, Notes and Engagement*. There will be a series of such articles, in *Connections* and elsewhere, based on the range of topics which are arising from our researches.

“...the end of all our exploring will be to arrive where we started and know the place for the first time.” (T.S. Eliot, *Little Gidding*)

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Of course, “for the first time” is an exaggeration: much of what we say is not original, but it is based upon what we have found. Our main aim in publishing these articles is to create conversations, to stimulate debate, and perhaps then to encourage experimentation and change. We mainly hope to engender reflection, for example about how something that seems to work well in one context may help to inform improvements in another. An aside may be interesting here. One of our project targets is to produce something which is called a “*Good Practice Guide*”. Now, we are wary of that title. We are aware that what works in one place and time may not be transferable unmodified, and those who are local know best what will work. We would prefer to call it “*A collection of good wheezes for which there is some evidence that they have worked well in one place at one time, when operated by a particular person, and which*”

the reader might like to reflect upon to see if the idea would help them to improve what they offer". Of course, this is a little less catchy.

Our collection of interesting stories and "good wheezes" arising from our researches is of course not comprehensive. In some cases we report what *The Times* has been pleased to call the bleeding obvious, but sometimes a reminder about the obvious is useful. In other cases there are some interesting and unusual things which we hope will provoke, and provide food for thought.

We do encourage readers to engage in conversations with us and others over the issues we raise in these articles and those which will follow. In addition, in the latter part of the project (autumn 2009) we shall offer consultancy support for those wishing to experiment with their practice.

To finish this current article, we shall make brief mention of progress on some of the other threads of the HE Curriculum theme of the project.

- We are looking at different kinds of HE provision which may contribute to increasing the numbers of mathematically qualified graduates and we are particularly interested in the possibility of a two year FdSc Foundation degree with significant mathematical

content. The only existing course with title involving the word "Mathematics" is FdSc Computing and Mathematics at London Metropolitan University. We have created a proposal for FdSc Mathematics with ... , and this is currently out for consultation with a range of employers, with the help of SEMTA, the Sector Skills Council whose brief includes mathematics. We will be reporting on progress when results of the consultation are available.

- We are looking at some of the range of pre-degree courses which may provide routes back into mathematics for adult learners. Aside from standard A level courses, the range includes preparatory years, access courses, and the only two remaining instances of the Polymaths course which some readers may recall. A publication is in preparation.
- A major thread of the whole project concerns careers for mathematics graduates, and in fact much of the material produced for the project will be bequeathed to the mathscareers.org.uk website. We are considering the place of careers materials and development within the HE curriculum, and will be reporting on particular examples of how this is handled.

We are pleased to receive correspondence, opinions and suggestions on any of the above issues.

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Lectures, notes and student engagement

We want our students to be as enthusiastic as we are about our subject. We pour energy into creating lectures and materials for them, and we are pleased when we perceive even just some of them as engaging positively and actively in learning. But to what extent does what we do encourage that? How best do we use our precious and in many cases declining contact time with students?

In this thread emerging from our More Maths Grads conversations with a range of staff and students at four HE institutions, we discuss the idea of engagement through lectures and notes.

Lectures

To those outside HE, and to some of us in it, the lecture appears to be the mainstay of our interaction with our students, setting their agenda and providing a major impetus for them to engage with the material. There

has been a good deal of thinking about the best ways to use lecture time, exemplified by the writings of generic educationalists such as Graham Gibbs or Phil Race, and also by more specifically mathematical projects, such as the MathsTeam project.

One concern has been to produce a less passive and more active experience for students. In spite of this, the traditional lecture still seems to be predominant, partly but not entirely owing to constraints of size. We all wrestle with the dilemma that we want to be starting where the students are – whatever that means – so that our lectures are immediately meaningful to them, but at the same time we feel constrained to "get through the syllabus". Leaving aside for this article the issue of who is imposing this latter constraint, the following quotes, from students who are succeeding, are thought-provoking.

“When I first got here I didn’t understand any of them, just like sat there copying what was being written but didn’t have a clue what they were on about. And I suppose it’s still like that, you just get used to feeling like that, you just get used to not understanding what they’re saying at all. Then you understand it later but not right there and then, just don’t have a clue what they’re saying sometimes.”

“... you want to put your hand up and say oh, like you used to at school just constantly put your hand up and say ‘can you just say that again?’ Or ‘what do you mean?’ And, but you obviously wouldn’t do that in a big lecture hall.”

We were led, then, to ask our interviewees whether a good lecture is useful, and what makes it so.

“Q: What do you think of lectures?”

A1: Depends on the lecturer.

A2: Yeah, it really depends.”

Once one gets past this personalisation, particular issues begin to arise. One theme which has emerged concerns the positive role of worked or illustrative examples, to aid with the digestion of blocks of theory. Here are some typical student comments.

“I go to all my A lectures ...if you miss an example of what he did in the lectures then you’re the one who’s losing out.”

“I don’t go to many of the B because I know I am not going to miss anything, because maybe once every couple of weeks he’ll do an example on the board. Unlike A where there are 3 to 4, 5 examples on the board each lecture.”

Upon further probing it emerged that B spends his lecture time reproducing printed notes on the board, and the students we spoke to were not impressed, and less moved to attend. One might wonder whether a positive effect can be achieved by putting worked examples in the notes, but consider this comment.

“Cos C actually writes in real time. So it’s as if he’s thinking while you’re ... like you’re doing it with him rather than just being told ... he’s writing at the same rate as you are ... you get it better because it’s a different sort of pace.”

It seems a lecture can add value over notes, as long as students can see mathematics being constructed, being *done* before their very eyes, rather than their being presented with a finished article.

Notes

The above discussion raises the issue of notes and handouts – whether on paper or on-line. Practice varies widely here, even within the same institution.

Students mention some courses particularly as having high quality notes, provided on-line:

“... the notes that the lecturer puts on the internet are very comprehensive and these are gone through in the classes.”

However:

“Students feel that they can get all the material without going along.”

This is a central point, and raises the issue of what is the purpose of on-line notes or handouts, and whether it is inevitable that providing good notes will send the message that you need not attend.

One lecturer, who makes all his notes available on a website “from the word go” observes:

“... they seem to like having nice structured notes with equations numbered and like everything nicely titled ... there’s a point at which they have to make their own decisions about how they’re going to learn ... I say to them, you know in principle you could do the entire course in your bedroom if you want, but I think it’s worth turning up to the lectures to listen to me talking about this stuff.”

Some students show that they think about this issue.

“... an awful lot of students have been asking for things to be more Internet based, as in the fact that they put up the notes and things like that. But then that can take away the sort of, sort of almost the human part of the fact of the lecturer and the sort of pupils listening.”

“Some people like to hear.”

Is what we are seeing here a reflection not only of the reality of student life nowadays, wherein their university course is only one feature of a busy life, but also of an awareness that different people will exhibit preferences for different learning styles?

We may ask about the purpose of online notes – for instance whether they are for students who have missed lectures to catch up, or to allow students to miss lectures, or to free students to listen in lectures without having to take comprehensive notes. Perhaps there is not a single answer – or if there is one, it is that we should acknowledge the diversity in our student body, both in terms of practical arrangements and in terms of the way different people prefer to learn, and should allow for that variety of styles in the way we provide our courses? Perhaps having done this, it is also worth being explicit with our students that this is what we are doing, and explaining why. They can then make mature and informed decisions.

There is one final point before moving on from this discussion of the role of notes. If some students are sometimes to rely upon printed notes then they need to be able to read them and understand them.

“Yeah, some people they just read it through hundreds of times and it still just look like garbage.”

Reading mathematics is a special skill. At least one of the current authors remembers an inspirational teacher who drummed into him that you never read mathematics without a pencil in your hand! Is this one

of the skills we expect our students to simply absorb or grow spontaneously, or should it be something we teach explicitly, say through comprehension exercises?

Attendance and engagement

Attendance has already been mentioned several times. Is it a problem? First some staff comments:

"In the first few weeks, 80-90% of our students show up. So in the first few lectures it is usually pretty crowded."

"It's quite exceptional that attendance rate let's say in week 10 is above 60%."

While these comments are not untypical, there is even within our sample, and in any one institution, considerable variation between courses/modules, from very high to very low levels, and varying across the year.

One can raise a wry smile by creating from our interviews stereotypical student comments about attendance:

We don't like 9am. We don't like 4pm. We don't like Mondays. We don't like Fridays. I don't like Wednesday because I play footie on a Tuesday.

But we have seen earlier that students can be quite strategic in their decision-making about when to attend. In general those students we spoke to realise when lectures are giving value over and above notes or books. In some cases, academic staff members recognise that the student body is not homogeneous, for instance:

"Mature students have other demands on their time ... it's a matter of finding the right balance."

The situation then is complicated. If students are engaging with the course does it matter if they are not always at lectures? The obvious answer to this is: it depends! If lectures contain vital *experiences* without which one will struggle to pass, then clearly attendance matters. If it is a matter of information giving, other sources can be made available, so while lack of attendance can damage or diminish one's learning it will not necessarily lead to failure.

Whatever the situation may be, academic course teams have a duty of care, notwithstanding the fact that our students are legally adults, to monitor and follow up on any students who are at-risk. The institutions we have studied do have systems, typically combining attendance data with in-year assessment data, and interviewing students who fall foul of agreed conditions. Indeed in-year assessment can prompt an improvement in attendance – or perhaps the opposite if one does too well!

At one institution, a member of staff summed up the attitude to attendance there, and in so doing mentioned an interesting initiative:

"I can't pretend that we've got brilliant attendance ... so long as they are engaging with the work and you can often

tell that from what they write in their log books, then we feel at least confident that they are still making progress..."

This institution has an integrated on-line learning log system. Through this, students reflect regularly and frequently on how things are going in exchange for a small amount of credit, and the entries can be seen by all staff teaching these students. There is thus a constant stream of information on how students feel they are engaging on all modules.

Other means of engagement: tutorials and assessment

While lectures are important in the culture of our discipline, there are other ways by which we interact with and encourage engagement from our students, including tutorials (or exercise classes, problem classes, surgeries, etc) and assessment. These will be the subject of a future article, but there are two points to make here which relate to the matter of this article.

The first point concerns what one student said about exercise classes:

"I find that ... one exercise class is worth three lectures, because you are actually physically doing the work and there's postgraduates there to help you."

This is a re-expression of the perception that the best way to learn mathematics is to do it rather than only watch someone else do it, or indeed just look at what someone else has done.

The spirit of this comment seems particularly apposite when considering classes which involve mathematical computing. One student commented that you *"can't learn computing away from a computer"*. Others in different contexts agreed with this sentiment. This was not to query the value of lectures in such areas, but to say that ideally if a lecture involves mathematical computing, then students should have concurrent access to a machine to allow them to try out what the lecture is demonstrating. But there was at least acknowledgement that such a wish was impractical at the current stage of development.

Of course with a relatively small group, as in one of our sample institutions, one can blur the distinction between lectures and tutorials and resort to classroom teaching, but when this More Maths Grads project succeeds, this is a luxury which none of us will have!

The second point concerns assessment and how it can be used in concert with classes to encourage and support engagement. One institution has been successfully using a weekly "little-and-often" assessment pattern, and this idea has been taken up, modified and is being trialled in a different context in a different institution, administered through the weekly lecture/tutorial system. Results of this transfer of practice are eagerly awaited.

Ideas that have worked well

We have looked here at issues around engaging students through lectures and notes, and the reactions of staff and students. While the situation is complex, as one might expect, certain points are worth summarising.

- In lectures, students say it helps them to come to grips with theory if illustrative examples are given. They particularly value live examples, seeing someone do live mathematics in front of them, at a pace which they can match. It is easier to do more of this if the lecturer is not tied by the constraints of an over-full syllabus.
- Good quality online notes are valued by students as a pragmatic back-up to lectures, but for students to get the best from the provision, it is useful to have an explicit rationale for why you are providing notes, and to explain that rationale to your students. Part of this explanation should be about how the provision of notes relates to lectures, and the place of each in their overall learning experience. You can then rely upon them to make the best strategic use of the learning opportunities you are presenting.
- Attendance is important but more so is engagement. Monitoring attendance is commonplace, but there is now some growing experience of monitoring engagement with the support of web technology.

- Finally there is some interesting experience being accumulated on the use of little-and-often assessment co-ordinated with the lecture/tutorial pattern.

Further Consultation

In this article we have presented and discussed some of the comments emerging from our conversations with students and staff specifically about engagement through lectures and notes. We would like to hear of different methods of encouraging or monitoring engagement through lectures and notes that have been tried, and how they have worked out. Please contact us if you have information which would add to the picture we have given above, or if you have any other comments on what we have written.

Editorial Comment

The issues of enhancing student engagement with mathematics lectures through the use of Electronic Voting Systems is discussed in the two articles by Robinson & King and Retkute published in this issue of MSOR Connections

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Student support

We aim for students to become autonomous learners, able to pick out the essential features of a problem, research any necessary information and construct a validated solution. For most students arriving into their first year, this aim represents a journey to a far horizon only achievable with substantial support. With the increasing age participation ratio and consequent wider mix of students a corresponding spectrum of methods of support is needed. Some students know when they need support and have the confidence to ask for it whatever system is in place. Others are reluctant to come forward to ask, don't know they need support, or have not understood what their local support system is.

As part of the More Maths Grads curriculum theme we have talked to staff and students at 4 institutions (including our own) about their perceptions of how Maths first years operate. One of the central strands which has emerged from

these conversations is support, and in this article we are going to briefly describe some of the recurring themes.

Friends

Three weeks into the course you are having trouble with the concept of a limit, or you have missed a vital stage in the solution process for an ode. What do you do? Hopefully by this time you have made one or two friends, so you could ask them, or you could seek out a member of staff. This might mean catching their eye in a tutorial, or perhaps even knocking on that initially forbidding door along the corridor.

The option with the lowest "leaving the comfort zone" threshold is to ask a friend, so it is not surprising that most of the students we talked to emphasised the importance of friends:

“the less successful students tend not to bond with other students”

“friends... who knew what they were talking about... could explain it in a language I could better understand”

“I don’t think it’s a good idea not to have friends when you’re in this”

“It’s just that I think you have more confidence with your friends. Cos you feel they’re in the same situation as you. As opposed to going up to someone who’s sort of above your level”

“our first choice is to go to our friends”

It is interesting that speaking to a friend is not only an easier option, but also seen as a better option because they are on the same level and “speak the same language”.

Perhaps the best thing that can be done initially to support students is to make sure that they have friends. Many students will naturally make friends, and we can’t ensure under all circumstances that all students will make friends. Nevertheless some engineering of the dynamics of first year groups may facilitate social bonds.

The creation of conditions conducive to productive friendships can be aided by:

- An attractive induction programme,

“The main purpose of induction week is to build up a community within the first years” “mainly a bonding exercise”

- Tutor groups and group projects,

“..we did things together in our tutor groups... that is how I met most of my friends... then gradually... you kind of sit down anywhere and everyone’s kind of interlinked”

- Accessible and convivial places for informal groups to meet up and work.

Some students find it difficult to make friends. This may be through shyness, natural inclination or force of circumstance. One international student for example pointed out that he did not have the same common points of contact as UK students and had found himself isolated at first when at the ends of lectures fellow students had quickly left. This implies the need for monitoring systems sufficiently robust to spot students who are isolated. As discussed below, personal tutoring systems, although helpful, are not necessarily a complete answer to this. When it is evident that a student is isolated then fellow students (especially mature students) are often willing to help, and a strong social structure within the group aids this process. Although not something that can easily be planned, the value of having a few good mature students in the group was highlighted by several staff. One such student was described as *“a nucleus for most of the good practice”*.

On-line

Email, texting, MSN messaging, bespoke on-line forums, Facebook and other increasingly interactive websites form part of the tapestry of social interaction amongst students and, probably lagging behind on texting, MSN and Facebook, also amongst staff.

Many institutions have their own on-line systems which, in addition to providing information sources, may allow for discussion groups and other opportunities for feedback. Two of the students we talked to said that their first port of call for support would be on-line rather than face-to-face to friends, one to a University system and the other to a Facebook group. This emphasises the extent to which electronic communication is integrated into students’ lives.

One feature of on-line communication that was raised in conversation is that there is a lot of contact between students in the different years of a course and this has both its good and bad aspects. On the plus side, students in later years can sometimes post answers to technical queries from first years, provide information from a student’s perspective about what to expect in later years, and generally encourage the building of a mathematical community across the years. A danger is that where a course is modified or assessment regulations change, students in later years can pass back information that is out of date and misleading.

Email has become a universal means of communication with students. It can save a personal visit, or lead into one in a way which is efficient for staff and less intimidating than a knock on the door for students. Prompt replies to emails (where possible) are evidence to students of a caring attitude from staff, and can foster further interaction.

“Both staff and students had mixed feelings about personal tutor systems. They seem to work best when they are linked with a specific task, particularly a group task. Otherwise, for some students they can be a very good support but many students effectively opt out.”

Personal contact with staff

Apart from lectures and other formal opportunities, direct contact with staff can be through a knock on the office door (pre-arranged or on spec) or through personal tutor systems of various sorts.

One member of staff put it to us that students we were talking to were generally quite happy to walk up to a lecturer’s door and knock, but they had volunteered to

be interviewed and hence were self selecting and not typical. His view was that other students found this much more difficult. Staff were generally happy to see students when they came, either with an open door policy, or with specified "office hours". They pointed out however that it would not be viable if all students from a large group came. Students report "occasionally" using office hours as a back-up to exercise classes and support from their friends.

Personal tutor systems usually involve meeting with personal tutees at the beginning of the year with possible pre-arranged follow up at points in the year, and the option of tutees contacting tutors in between. Sometimes a tutor group project is linked in which can be useful in helping tutees to form friendships, as noted above.

One student commented that contact with personal tutors was a useful way of feeding information back and getting things sorted out if there are problems with other modules. The international student mentioned above said that, feeling rather isolated, the personal tutor system had provided him with at least one member of staff who could be his "confidante". On a big course, members of staff can have up to 30 tutees which limits the extent to which tutors can get to know their students. Some staff reported that it was difficult to persuade students to turn up for pre-arranged follow-up sessions. Both staff and students had mixed feelings about personal tutor systems. They seem to work best when they are linked with a specific task, particularly a group task. Otherwise, for some students they can be a very good support but many students effectively opt out.

Drop-in sessions

Many courses have drop-in sessions in one form or another, staffed at certain hours of the week by either staff or higher level students. These were well used by students and thought to be helpful, a useful feature being that a different person explaining something sometimes gives a different perspective.

The following quotes are typical of the positive reactions towards drop-in sessions:

- *"It's pretty good though" "I find it, I find it useful. I find it very helpful" "You know I think they're quite good motivators as well."* (Students talking about a drop-in staffed by higher level and PG students).
- *"found to be very useful with one particular lecturer excellent at explaining"* (On a daily drop-in session staffed by lecturers).

Ideas that have worked well

We have looked here at a range of support methods and the reactions of staff and students to them. As would be expected, there is not a consensus about the best methods of support, and a range is needed to provide

a good service to all students. While many students cite their friends as their first port of call for help, others go to on-line discussion groups, and some to a personal tutor. Nevertheless it is possible to pick out some guidelines on what has worked best.

- Students receive a huge amount of support from friends. The building of social bonds and informal working groups can be encouraged through an induction which has social interaction as a high priority, by group projects perhaps linked with personal tutors and by the provision of convenient and convivial group working spaces.
- On-line forums are there and will be used with or without staff intervention. If used in the right way they can provide a ready source of support and help to build the mathematical community. They do however need monitoring to ensure appropriate use and the current relevance of information provided.
- Drop-in sessions are seen as very useful by students, partly because of their guaranteed availability and also because an alternative explanation from another person can help to give a different perspective on a problem.
- Personal tutor systems work well for some students but are under-used by the majority. This may be improved by linking in a project to be carried out by a group of tutees and overseen by the tutor. While some students are confident to knock unannounced on office doors, many find this difficult - possibly including those who need extra support most. Students may be encouraged to seek help in this way through email dialogue.

Further Consultation

We have distilled the comments specifically about student support that have come up in our conversations with students and staff. Although we have talked to a number of staff and students in each of four institutions, this is a small sample compared to the total UK HE environment. We would like to hear of different support methods that have been tried, and how they have worked out. We would be interested, in particular, in hearing about use of on-line applications. Please contact us if you have information which would add to the picture we have given above, or if you have any other comments on what we have written.