
Teaching - It's All in the Mathematics

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While pondering the design of some induction materials for mathematics lecturers, I was struck by how complicated teaching in HE is these days. There is so much to think about when you sit down to design a course or a whole programme. Even when we contemplate a single lecture there are a whole range of things we need to consider. So, I started listing all the things we have to take into account when designing a whole programme, a single module or even an individual lecture. I pruned, tidied, categorised, mused about it all, had my 'eureka' moment and – well, see what you think. It is in the **MATHEMATICS**.

MATHEMATICS

These days, the very first thing to take into account in designing programmes, courses, etc is the range of resources (from equipment to (wo)manpower to accommodation) available to you. This given we then need to think hard about **MATHEMATICS**:

<p>Mathematical content</p> <p>Aims and objectives of the curriculum</p> <p>Teaching and learning activities to meet the aims and objectives</p> <p>Help to be provided to the students - support and guidance</p> <p>Evaluation of the curriculum and its delivery</p> <p>Materials to support the curriculum</p> <p>Assessment of the students</p> <p>Time considerations and scheduling</p> <p>Initial position of the students – where we are starting from</p> <p>Coherence of the curriculum – how the different components fit together</p> <p>Students</p>

A survey of all the major treatments of university teaching and learning persuaded me that the above list covers most things of significance that need to be considered when designing and delivering the curriculum. The acronym (not one we are likely to forget!) is too good for us to be worried about the order of the importance or treatment of these issues, but in fact we normally need to consider them in parallel anyway. There will inevitably be some overlap and repetition between the different headings, but it is better to be reminded more than once than to forget altogether.

Mathematics for a Single Lecture

Obviously, the **mathematical content** of the lecture is important, and although we don't usually have lesson plans we do have to think about the **aims and objectives** of the lecture. Usually the **teaching and learning activity** is a lecture or tutorial, although it may be a lab class in stats or numerical methods. **Help** and support for the students may simply amount to directing them to a section of a text, or giving a handout on a difficult point. Maybe it is time to give out a student questionnaire, but in any case we should be continually **evaluating** how the class is going. And what **materials** do we need for this lecture – a problem sheet, a few OHPs? In terms of **assessment**, do we

need to hand out/collect in coursework or tell them something about the upcoming exam? Do I have **time** to cover the next topic today, have I got to tell them the exam dates? Normally, if we are following on from previous lectures, we know the **initial position** of (most of) the students, but it is a good idea to remind them where we got to last time. And if it is the first class of the session then we may even need some sort of review. In fact does it follow on from the last lecture, or is it a new topic altogether, in which case we have to explain the links to the students, to ensure the **coherence** of the module? Finally, remember why we are there – for the **students**. Give them a fair deal, and think whether you need to see particular students after the lecture for some reason.

So we can see that even for a single lecture it can help to do a little **MATHEMATICS** beforehand. Of course, we may have to think about other things as well, but this provides at least a basic minimal set.

Mathematics at the Level of a Module

At the next level up from the lecture you may have to design a new module from scratch. This is a significant job of applied **MATHEMATICS**.

Mathematical Content of a Module: Influenced by departmental aims, the overall degree programme, student needs, the level of the module, your own interests, possibly accreditation requirements, and much more besides. Even if you inherit a 'standard' syllabus there will still be plenty of room for interpretation of the content. You can get ideas and guidance about content from books, your colleagues, etc. If you studied the topic at university, you may also have your old notes you can consult.

Aims and objectives of a module: These days this is the systematic means of describing what it is we expect the students to be able to do on completion of the module. There is plenty of advice around these days on how to write aims and objectives at various levels of the curriculum. Teaching activities and assessment need to be aligned with the aims and objectives, and students have to be informed about them.

Teaching and learning activities to meet the aims and objectives of the module: The choice of teaching and learning activities to meet particular objectives is determined partly by our view of how students learn. The standard teaching activities in maths are pretty much accepted as lecture/tutorial, chalk and talk and problem solving, but even in maths it is now common to have computer lab classes, and some modules are

web delivered. So a maths learning environment may not simply be a classroom. For any given learning objective there may be a range of teaching and learning activities to achieve it, and our choice will depend on resources and indeed the whole of **MATHEMATICS**.

Helping students – support and guidance: Above all teaching is one person **helping** another – having to help a lot of students all at the same time sometimes masks this fact. And the best time to teach anyone is when they want to learn, for example when they come to see you, or ask a question in class. Helping the students needs objectivity and patience, good availability, a good rapport with the students and a respect for them. Some departments issue students with helpful material giving advice about learning mathematics.

Evaluating, managing and administering the module: Evaluation is the means of ensuring that the learning objectives are being achieved. We should be continually evaluating what we do, as we go along, and we can design evaluation in from the start. There are now plenty of means of evaluating our teaching, student questionnaires, peer observation, etc. We also need to plan for changes as result of evaluation, and for giving feedback to the students. There is also the associated administration material and module information, general housekeeping, all of which needs to be planned and prepared.

Materials to support the module: Depending on the subject, we may need to prepare some or all of the following: module specification containing aims and objectives, exam schedule, timetable information, contact information, course notes, problem sheets, reading lists, coursework and solutions, worked examples, specimen exam paper, revision material, tests, examination papers, project specifications, case study notes, computer software/practicals, student questionnaires. You can probably keep adding to this list! Whatever we do, preparation of materials usually takes significantly longer than we expect.

Assessment of the students: Assessment seems like the last thing we do with the students, but in fact we have to think of it right from the beginning. The minute we write down our aims and objectives, we are essentially defining the nature and form of the assessment. We need to decide on the form of the assessment. Exam? When, how long? Seen/unseen? Form of questions, how many, etc, etc? Overwhelmingly, at least for most cognitive skills, the assessment of choice in mathematics is the closed book, unseen, time-limited exam. Assessed coursework may be required even earlier than an exam, and again needs front loading. Then there is setting,

moderating and marking assessment, all time consuming.

Time and scheduling considerations: When designing the curriculum we need to constantly keep a check and estimate how much time is needed to achieve the objectives. The actual contact teaching time may vary, but most modules have a nominal learning time of say 100 hours. This is what you should then work to in terms of the students' workload. Into this time must go any coursework you set, and the scheduling of this needs to be considered so that bunching of workload is avoided. Then there is the timetabling of the module, and the scheduling of such things as exam boards.

Initial position – students' preparedness: Mathematicians do not need to be reminded of the importance of initial position. The consequences of getting the initial position wrong may be chaotic! We need to know as much as possible about the students' backgrounds in those areas of maths that we rely on. This is particularly so in the first year. We may use 'diagnostic' tests to determine students' background so we can adapt our curriculum accordingly. In second and subsequent years we can be guided by what we now 'know' they have done, although we may still need to fit in a bit of revision. We also need to understand the level of mathematical maturity of the students, which may be low in the first year, but hopefully much higher in the final year.

Coherence: The topics in the module should proceed step by step in sequence. Any sudden changes of direction need to be well sign-posted and explained. Give clear linkages between what students already know and the new material, and between different areas in the new material.

Students: Last but not least! All that we have said above should always keep the students in mind. Students present a full range of capabilities, weaknesses, personalities, motivations, attitudes, problems, fears, etc, just like any collection of people. The big problem is to deal with them as individuals amongst the crowd. Sometimes, when faced with a difficult issue or problem arising in the teaching, it can often be resolved by asking yourself, 'What is best for the students?'

Mathematics at the Programme Level

Not a frequent problem for most of us, yet the mnemonic is still useful in helping to map out the areas for consideration in designing a complete programme. The **mathematical content** now comprises a whole range of subjects, depending on the overall **aims and objectives** of the programme. A complete range of **teaching and**

learning experiences will need to be provided, along with **help** for students that may include services across the institution, personal tutoring systems, etc. **Evaluation** will include student questionnaires, peer review, institutional review, etc. The amount and range of teaching and learning **materials** will of course have resource implications. Apart from the **assessment** of each module in the programme we now have to consider how the overall degree classifications are put together, for example. **Time**-tabling is clearly a major issue for a complete programme, as well as the scheduling of staff student consultation, exam boards, etc. Naturally the programme curriculum has to be designed to take account of the **initial positions** of the sorts of students we recruit to the programme, and once they are on board we must ensure the programme is **coherent**, and that everything hangs well together – a significant challenge in modularized provision. Last but not least, the provision should be **student** centred, designed around them.

Conclusion

The **MATHEMATICS** categories provide prompts for things we need to consider in teaching at all levels of provision – programme, module, lecture. It is worth noting that only the initial **M** relates directly to actual mathematics, everything else is essentially generic and would need consideration in any discipline. For example in physics one could have **PATHEMATICS!** The acronym also reminds us (and perhaps more importantly, others) how much there actually is to teaching.

Editor's Note: MATHEMATICS posters are available on request or can be downloaded from the mathstore website at:

<http://itsn.mathstore.ac.uk/posters/mathematics.pdf>

or contact:

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