

The ‘Teaching Advanced Mathematics’ Programme of Professional Development

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Abstract

The ‘Teaching Advanced Mathematics’ course of in-service professional development is a 16-month part time course providing teachers of secondary school mathematics of students up to age 16, the opportunity to acquire the subject knowledge and pedagogical skills to teach A level Mathematics, the post-16 pre-university course in mathematics for students in England. This paper looks at the lessons learned during the four-year pilot.

BACKGROUND AND COURSE DESIGN

There is a well-publicised shortage of specialist teachers of mathematics in England, see ACME (2002), Smith (2004) and DfES/DTI (2006). There is some debate over the definition of the term ‘specialist’ teacher; the Department for Children, Schools and Families (DCSF) currently defines a ‘non-specialist mathematics teacher’ to be a qualified teacher whose degree does not incorporate a significant element of mathematics, who has not specialised in mathematics during his or her initial teacher training and who has not participated in a DCSF-funded course designed to increase the pool of specialist teachers. This definition is, however, problematic. See Question 1, for discussion, below.

The ‘Teaching Advanced Mathematics’ course¹ of in-service professional development was designed to give non-specialist teachers of secondary school mathematics the subject knowledge and pedagogical skills to teach A level Mathematics, the pre-university course for students in England.

The course is offered through four universities and centrally managed by Mathematics in Education and Industry (MEI) an independent UK curriculum development body.

The course, which has been offered since 2004, runs from June one year to September of the following year, thereby incorporating two summer holidays. Participants benefit from the expertise offered by both MEI and the university. This collaboration has proved highly effective in meeting the needs of teachers.

MEI, through the Course Manager, brings coherence to the course at the various universities, to the benefit of all participants. MEI ensures that high quality on-line resources (<http://resources.mei.org.uk/>) are available to participants at all centres to support their learning and teaching of A level Mathematics. In addition, MEI provides participants with all the support they need in terms of acquiring subject knowledge, understanding its place within

¹ <http://www.mei.org.uk/tam.shtml>

the wider framework of Mathematics and experiencing a range of effective ways of teaching it. The purpose-written, web-based resources, on-line lessons in a virtual classroom <http://www.elluminate.com/> and regular e-mails give teachers a focus and structure to their independent studies. Throughout the course, all participants regularly teach A level Mathematics and the school visits, undertaken by MEI and the university course tutors, give participants one-to-one advice, support and ideas for use in their own classrooms.

At the nine study days spent at the university, the participants are introduced to the research underpinning the teaching and learning of A level Mathematics. Successful course completion leads to the award of a Postgraduate Certificate.

Course development has been influenced by the findings of the external evaluators, the Curriculum, Evaluation and Management Centre (CEM) at Durham University. Further research is currently being undertaken by the National Centre for Excellence in the Teaching of Mathematics (NCETM) as part of their Researching Effective CPD in Mathematics Education (RECME) project and Jill Adler, using the QUANTUM research methods (Adler (2006)).

The four-year pilot is now coming to an end. Course participants, their colleagues and the external evaluation team have reported significant on-going progress in terms of participants' enhanced subject knowledge and teaching skills at all levels of the secondary curriculum. It is anticipated that the course will receive government funding to be rolled out on a wider scale.

FACTORS INFLUENCING COURSE DEVELOPMENT

In designing and developing the programme, MEI, the course leaders at the universities and the evaluation team have continually returned to the questions below.

Given the restrictions on teachers' time, is it viable to run a substantial course of professional development to equip non-specialist teachers with the skills to teach A level Mathematics with confidence?

The course requirements involve a substantial amount of private study. This is demanding on the time of participants, but the evaluation reports that the majority respond positively to this, and benefit from the personal development involved in learning to manage their study time effectively against other commitments.

Two features of the course design figure prominently in feedback from participants.

- The email support and on-line lessons allow participants to progress at their own rate whilst giving structure to their private study between university days. They can rely on the website as a source of high quality resources, and the detailed guidelines linked to resources ensure that they are used effectively in the classroom.

- The tutors are seen to model good practice on the university study days which inspires participants to reflect on their own teaching at all levels and gives them the skills to analyse the learning taking place in their own lessons.

It should be noted that the course participants are typically committed and dedicated teachers with a desire to improve their practice, and the successes of the course need to be viewed in this context. See Question 2, for discussion, below.

Can a 16-month course set teachers on a route of continuing professional development giving them the independence to acquire further knowledge and pedagogical skills?

Experience has shown that the course provides many of the participants with a new direction in their teaching careers and is a gateway to further professional development. Indeed, many of the participants from previous years are now continuing with further study towards a Masters degree or following MEI's 'Teaching Further Mathematics' course (<http://www.mei.org.uk/cpd/tfm.shtml>). Research is currently being undertaken to establish the effects the course has had on participants' careers and this should be available at the ICME conference in July.

How important is it for a course of this nature to carry a Masters level qualification?

All participants are free to choose whether they want to submit work for the Masters qualification or simply benefit from the support the course offers. The evaluation team have found that most participants see the university assessment as relevant to their professional lives, and so choose to complete the assignments required to qualify for the Postgraduate Certificate, even when this was not their intention at the outset. For some participants the qualification was seen as an important aid in seeking promotion in their career, whereas for others this wasn't an issue.

Whilst universities attract funding for each teacher enrolled on their CPD courses, almost inevitably the number of teachers deemed to successfully complete the course could affect funding at some point in the future. Therefore, the universities are keen to ensure that assessment is closely linked to the professional lives of teachers and thereby encourage more participants to submit work for the qualification.

What are the most appropriate forms of assessment: engaging with research, reflecting on the process of learning mathematics or classroom-based research?

Whilst all four universities have broadly similar modes of delivery, the universities themselves are independent awarding bodies whose requirements for accreditation and certification differ, so local courses must meet the requirements of the university at which they are based. The flexibility in the programme has allowed each university to design a

distinct way of assessing the course. This has included essays on aspects of A level Mathematics pedagogy, ‘classroom based enquiry’ involving research into an issue of the participant’s choice, and mathematical investigation in which participants reflect on the process of working on mathematics and the implications this has for their teaching. All of these have proved popular with participants but the latter two, due to their open-ended and more extended nature, have required careful staging posts. In general, participants have been more aware of the positive impact that engaging with, and reflecting on, research has had on them. Six-monthly meetings of the course leaders from the four universities have allowed them to share good practice and adapt their course assessment.

Given the participants’ needs in terms of learning the content of A level Mathematics, what is an appropriate balance on the university study days between devoting time to mathematics, its pedagogy and engaging with research?

It has been important to get the balance right on the university study days between devoting time to mathematics and its pedagogy whilst also ensuring the University’s requirements for what constitutes an academic course at this level are met. The feedback from the participants as evidenced in the evaluation reports gives a clear indication that the balance achieved meets their needs and expectations.

Each university study day has a focus on a particular mathematical topic (such as calculus and limits, proof and reasoning, functions) along with an aspect of pedagogy (such as assessment issues, differentiation, ICT). During the day, there is usually a one-hour lesson modelling good practice, focusing on the mathematical topic of the day and the general aspect under consideration. The lesson forms the basis of a discussion of the research into, for example, student misconceptions in this topic and the nature of effective questioning, and the participants reflect on their own learning experience in the lesson. They are challenged to think about mathematics in a way that takes them beyond the comfort zone of typical A level textbooks and become aware of the difference between teaching concepts as opposed to merely teaching techniques.

To what extent are the pedagogical skills acquired on the course, in the context of A level Mathematics, transferable to teaching Mathematics at other levels?

Whilst on the course, participants develop their understanding of Mathematics and its pedagogy to a much greater depth. This has a positive effect on their teaching at all levels from, typically, age 11 upwards, thus enabling them to present a joined-up view of mathematics throughout a student’s time at secondary school. In addition, the resources and pedagogy that participants are introduced to whilst on the course are shared with their teaching colleagues in their schools and colleges and, as a result, they report an increased level of discussion of pedagogy within their departments.

I end with two quotes, typical of those made by teachers towards the end of the course.

“The course has changed my outlook on my teaching and on my view of the nature of mathematics...and although I begrudged every assignment, it was of great interest to begin to have an intellectual understanding of what I'm doing. ... I would say that such a course should be made compulsory to all maths teachers after a few years teaching experience as there does not seem to be any other worthwhile and rigorous inset.”

Course participant, London South Bank University, 2006-07

“...It is disappointing that this is my last university session. I feel I have achieved so much, my confidence has grown, my questioning skills have improved and I employ such a wide variety of teaching methods that more experienced teachers are now observing me for new ideas!!”

Course participant, Warwick University, 2005-06

References

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Questions for the discussion group

1. The UK Government's Department for Children, Schools and Families (DCSF) defines a 'non-specialist mathematics teacher' to be a qualified teacher whose degree does not incorporate a significant element of mathematics, who has not specialised in mathematics during his or her initial teacher training and who has not participated in a DCSF-funded course designed to increase the pool of specialist teachers. However, many teachers on the course do not meet any of these criteria but feel that they are not specialists as their mathematical education did not prepare them to teach at this level. How do other countries define a non-specialist teacher and what support does this status entitle such teachers to?

2. There is a move in the UK to make teaching a Masters level profession. It is expected that teachers will undertake in-service Masters level courses in their first few years of teaching. It is recognised that enhancing subject knowledge is an important part of the CPD of mathematics teachers but universities find it difficult to accredit this work at Masters level; consequently much of the work undertaken by teachers on such a course will not count towards the award but significantly increases the time commitment required. How might universities recognise this if they are to attract all teachers onto courses, and not just the highly motivated teachers currently engaged in sustained CPD?