ACME

Advisory Committee on Mathematics Education

Ensuring a high quality, localised infrastructure for the Continuing Professional Development of teachers of mathematics

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Foreword

Sir Peter Williams CBE FREng FRS, Chair of the Advisory Committee on Mathematics Education (ACME)

The Advisory Committee on Mathematics Education (ACME), established by the Royal Society and the Joint Mathematical Council of the UK (JMC) in 2002, provides a single voice to the Government on mathematics education issues in England. Between February and April 2005 ACME undertook a feasibility study to consider possible models for a high quality, localised infrastructure for the Continuing Professional Development (CPD) of teachers of mathematics.

The purpose of the study was to inform the establishment of the planned National Centre for Excellence in the Teaching of Mathematics (NCETM), but it is also hoped very much that this report of the study will be viewed as a useful contribution to the ongoing debate about subject-specific needs for teachers. ACME's first policy report in December 2002, which proposed the establishment of a National Academy for Teachers of Mathematics together with Local Mathematics Centres, was endorsed by the then Secretary of State for Education and Skills in March 2003 and incorporated by Professor Adrian Smith in his report on post-14 mathematics published in February 2004. Mindful that an infrastructure for the provision of science-specific CPD for teachers is already in operation, ACME looks forward to the establishment of the NCETM and its associated localised infrastructure for the provision of mathematics-specific CPD, as soon as possible.

Details of ACME's current membership and activities are available at **www.acme-uk.org**

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ACME
The Royal Society
6–9 Carlton House Terrace
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Executive summary

This report of an ACME feasibility study on a proposed high quality, localised infrastructure for the Continuing Professional Development (CDP) of teachers of mathematics[1], is factual and evidence-based and reflects views taken from the mathematics education community, including those of policy makers and ground-based professionals in the same organisations. The report looks firstly at teachers' expectations and needs, originally highlighted by ACME's 2002 policy report on CPD for teachers of mathematics[2], including: types of CPD that have worked for them; time and access issues; remuneration for attending courses; accreditation for completion of courses; and quality assurance of provision. It then sets out ACME's preferred model for a CPD infrastructure. This would link the planned National Centre for Excellence in the Teaching of Mathematics (NCETM) to localised provision through 'co-ordinating hubs' of a Regional Mathematics Centre (RMC) in each of the 9 Government regions, within which would be local network co-ordinators, their numbers depending on the needs of the particular regions. Finally, it makes specific recommendations to those entrusted to run the NCETM and the localised CPD infrastructure (see below), as well as highlighting some of the risks to the whole system, including the over-riding threat of a failure of joined up, long-term, strategic thinking on mathematics education issues.

Summary of recommendations

- The NCETM should set up RMCs based on the nine Government regions in England, and then, within the RMCs, create local networks with co-ordinators.

- As a matter of priority, the NCETM should work over the 3 years to develop a sustainable model for CPD in mathematics.

- The NCETM and RMCs should have co-ordinating (rather than providing) roles, linking the many existing networks and ensuring that the provision is of the highest quality. They must develop strategies to assess whether there has been a positive impact on the teachers and their students.

- The NCETM should develop a strategic role in relation to CPD by working with the Chief Adviser for Mathematics at the Department for Education and Skills and others in key national roles, developing priorities that bear in

1 Throughout this document the word 'teacher' includes those referred to as 'lecturers' in the further education sector.

2 ACME 2002. *Continuing Professional Development for teachers of mathematics*. London: The Royal Society.

mind the personal development needs of the teachers as well as those of the schools and colleges where they work, and those agreed nationally.

- The range of CPD opportunities should be broadened, for example by considering the types and lengths of professional development courses available in the 1970s and 1980s. The NCETM should identify gaps in current provision and stimulate others to plug these gaps.

- A culture should be created where teachers accept some responsibility for their own development and which encourages them to be more proactive in this, while working within their school or college systems.

- The NCETM should clearly define what is meant by 'continuing' professional development and clarify what is meant by teachers' entitlement to this. Consideration will need to be given to how time can be provided for reflection, for actions and for dissemination to colleagues after a course or other CPD experience and how to engage more people in subject-specific CPD. Related funding issues need to be considered and recommendations made.

- The NCETM should work with others, such as the Teacher Training Agency, the General Teaching Council and the National College for School Leadership, to ensure that head teachers and senior managers in schools and colleges understand the particular need for subject-specific CPD in mathematics and are imaginative in finding ways of creating time for this to occur. There is also a need to look at the management of mathematics teaching across many further education colleges.

- The new structure should encourage greater interaction between Higher Education Institutions and schools and colleges.

Ensuring a high quality, localised infrastructure for the Continuing Professional Development of teachers of mathematics

Background

1. In December 2004, Charles Clarke, who was then the Secretary of State for Education and Skills, announced the first step towards the establishment of a National Centre for Excellence in the Teaching of Mathematics (NCETM). This was in response to Professor Adrian Smith's report on post-14 mathematics *Making Mathematics Count*[4] and a realisation that improving the Continuing Professional Development (CPD) of teachers of mathematics in all phases is key to raising the quality of provision for children and young people and the standards they achieve.

2. At the request of the Department for Education and Skills (DfES), the Advisory Committee on Mathematics Education (ACME) set up a feasibility study to explore the best possible way of linking the NCETM with a high quality, locally offered programme of CPD for teachers and lecturers of mathematics in all phases of education. This included those who teach mathematics as a service subject and careers officers who advise on career pathways post-16, as well as those who work with the youngest children in the educational system.

3. The study sought to find the most effective ways of co-ordinating and extending existing provision in mathematics and identifying and plugging gaps. It was also important to try to ensure that there is equality of opportunity for teachers of mathematics to engage in CPD wherever they live and work in England, and in whatever phase they work.

4. Much of the provision in primary and secondary schools is well known, but there is little information in two important areas: Early Years and further education (FE).

5. Subject-specific CPD provision is not yet well established for those teachers and practitioners working with young children. This is often because they fall outside the priorities determined by the Primary National Strategy (PNS) to improve school performance in end-of-key-stage tests. There are particular issues for small primary schools where a few teachers have responsibility for all the subjects of the National Curriculum, and also for staff in secondary schools who have other responsibilities, such as

3 Smith, A. 2004. *Making Mathematics Count. The Report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education*. London: The Stationery Office Ltd.

Heads of Year. In a sense the latter are the same as part-time teachers who often cannot attend departmental meetings.

6. CPD is harder to access in the FE sector than in schools and there is little knowledge of the impact of CPD in colleges or in work-based learning across the sector. Although some FE colleges have very high standards of mathematics teaching, the majority are routine at best. Heads of mathematics departments in colleges of FE rarely co-ordinate the whole of the teaching of mathematics in their college because of the range of provision occurring in different departments, and the wide age range of the students. Few colleges have a 'mathematics across the college' committee and a planned approach to CPD. Another problem is the reliance on a large number of part-time staff and non-specialist staff in many instances. The training needs on work-based courses are particularly hard to gauge because the employers themselves are unclear of their own requirements.

7. *Making Mathematics Count* stated that:

   '… it is essential for teachers of mathematics to have sufficient subject knowledge to challenge and develop the full range of students they teach. Broadening and deepening mathematical knowledge and understanding are essential. … For teachers of mathematics broadening their knowledge of subject specific pedagogy is appreciating how students learn mathematics, the role of questioning and response, and the potential obstacles to learning that students are likely to face. [Teachers should] reflect on different approaches to delivering the mathematics curriculum … how it is structured in terms of progression within each topic, the links between topics, and the way topics are revisited in different contexts… . Individual teachers have different combinations of pedagogical skills, mathematical knowledge and experience of teaching. For this reason, subject-specific CPD provision should be sufficiently flexible to respond to the individual needs of teachers and enable teachers to identify how these needs can best be met. A range of provision must therefore be available at different stages of teachers' careers and at different points in their mathematical development'. (Extracts from paragraphs 5.34–5.37.)

8. The Government not only supported the proposal for a NCETM but also acknowledged that mathematics was a special case in terms of CPD, and has since set policy objectives underlining the centrality of CPD. It accepted that for all teachers, at every stage of their career, there are three important aspects of CPD. These are the need to:

- develop a depth of personal subject knowledge to underpin teaching and learning;
- enhance their repertoire of subject-specific teaching methods and pedagogy; and
- apply general strategies for teaching and learning.

The Government has also stated that while this applies generally to teachers of all subjects, research has shown that for mathematics in particular the subject-specific elements are critical in raising levels of students' interest and attainment.

9. At a time when a major report has recommended the need to improve the mathematical knowledge of many teachers, there has been a loss of subject expertise on the ground. There are fewer mathematics advisers in local education authorities (LEAs), for example, and the regional directors in the PNS are now expected to perform a generalist primary role. Many mathematics co-ordinators for the PNS are not specialists in mathematics though they are experienced primary teachers, and their training needs must be considered.

10. This study is about the establishment of a national infrastructure that links into and complements existing networks and CPD provision. Nurseries, schools and colleges belong to many networks, frequently of a general nature, such as Education Action Zones (EAZs), Excellence in Cities (EiC) and Early Years networks. New ones will be built up around Children's Centres. It is important that these are included in the local considerations and their work built on for subject purposes.

Evidence base for the feasibility study

11. Views were sought from practising teachers from a wide range of organisations that provide training and support. These were achieved through questionnaires, meetings and telephone conversations. Some people were chosen for interview because of their various roles over time; for example as a teacher, then subject co-ordinator, then advisory teacher and then adviser.

12. Meetings were held in three very different geographical regions — Truro in Cornwall; Wisbech in Cambridgeshire; and Greater Manchester — to which teachers in all sectors and representatives from LEAs, the national strategies and other local providers were invited.

13. More local meetings were organised with Early Years practitioners, and with local FE and sixth form colleges. One visit was made to an engineering firm that organises training through a local FE college and does some on-site training.

14. A visit was made to the London Mathematics Centre, which is running a mathematics-specific CPD pilot scheme for 3 years, and one of

its pilot schools. A group of over 30 mathematics PGCE students in Manchester talked about their hopes and aspirations as they embarked on their careers.

15. Relevant documents based on inspection evidence were received from HMI and Ofsted. Additional information was obtained at the 6th British Conference on Mathematics Education (30 March–2 April 2005), especially from the opening and closing sessions given respectively by Professor Celia Hoyles (Chief Adviser for Mathematics at the DfES) and Professor Mike Askew (King's College London).

16. ACME's own report *Continuing Professional Development for teachers of mathematics* remains a very pertinent document. [4] It recommended that a national academy for teachers of mathematics be established and this was supported by the Smith report. It also stated that:

'By a Continuing Professional Development (CPD) programme, we mean a sustained and developmental programme; this could comprise different sets of professional development and some training put together so as to be progressive over time to reflect a teacher's needs . …Thus a CPD programme in mathematics typically will continue over years, planned by the teacher in collaboration with a head of department, a Head Teacher or mathematics co-ordinator or others with expertise, with the aim of enhancing the knowledge, skills and enthusiasm of the teacher.' (p.1)

4 Op. cit., note 2

Teachers' expectations and needs

Professional development that works

17. The responses confirmed that there are many existing networks that support teachers at local, regional and national levels and that these should not be lost in any new structure. However, teachers (and advisers and co-ordinators in particular LEAs) would like to have more direct access to information about courses and developmental opportunities, for example, in a neighbouring LEA. Teachers want to be proactive in their own development rather than reactive to the provision offered. Some teachers do not always receive information at present because it is dependent on someone else in the school or college — usually the head teacher or head of department — passing on the information.

18. Older teachers spoke of the most significant influences on their professional development. Things that had shaped their careers had frequently been the involvement in curriculum development projects such as Mathematics in Education and Industry (MEI), PrIME, SMILE Mathematics, School Mathematics Project (SMP) 11–16 and 16–19; working in development groups for the subject associations; attendance at HMI Invitation Conferences and DfES Short Courses; working for awarding bodies; attending courses (run regionally) for aspiring heads of department; work for the Mathematical Association (MA) diplomas; and working on Open University courses such as Project Update. These had mainly taken place in the 1970s and 1980s.

19. Looking back, the courses and activities that had been most appreciated were those that had (i) given a longer term perspective, and (ii) concentrated on ways of working with children and young people so that they were engaging with the mathematics. The teachers had also appreciated courses where they had picked up ideas for almost immediate use in their classrooms, especially in relation to the use of information and communications technology (ICT). However, they acknowledged that there was also a need to reflect on when ICT was helpful as a teaching aid for conceptual development and when pencil and paper might be more effective. New teachers are particularly keen to have access to ideas for their lessons, especially interesting ways of introducing a topic and (possibly) with a historical perspective.

20. People spoke of others who had influenced and encouraged them, giving them the self-esteem and confidence to go on and tackle new challenges. Being encouraged to share a good idea with colleagues in

school or to write an article for a journal had helped the person's professional growth. Sessions that had been firmly rooted in research but presented with a focus on its translation into classroom practice had been appreciated. Being involved in research based in their own school had been very formative for those teachers involved. They had benefited from the opportunity to focus on their own work but also from being able to talk to others, especially those in Higher Education Institutions (HEIs) with research experience who were overseeing the process.

21. This type of personal professional development has largely disappeared with the more 'top-down' model from the national strategies which has dominated in recent years. This has focused on improving results at the end of Key Stages 1–3, and has particularly targeted poorly performing schools. Courses provided by the strategies have involved large numbers of teachers and have given many primary and Key Stage 3 teachers more confidence in the subject, but the scope of these courses has, however, been limited because of the national priorities.

22. Teachers value the regular updating they receive from the national strategies, the awarding bodies and some LEAs; they have spoken highly of short courses they have attended with this purpose.

23. Courses run by the awarding bodies have been very popular with Key Stage 4 and sixth form teachers because of their direct focus on the examinations. The Government's commitment to improvements from 14+ by raising attainment at Levels 1 and 2, and enhancing engagement in and motivation for mathematics, needs to be seriously addressed. This will not be achieved by simply focusing on the examinations or end-of-module tests. Attention needs to be paid to the learning experiences of the students in order to secure their motivation and longer-term engagement.

24. Some respondents spoke of the very successful 20 day courses for mathematics co-ordinators, which occurred in the late 1980s. (The 20 days were spread throughout the school year). There has recently been a shift away from longer accredited courses, but the PNS has recently developed 5 day courses. These consist of 3 days away from school with a dedicated day in school between each of these days. This is usefully building in time for the teachers to reflect and put into practice what they have been learning and discussing. There should be scope in the new system to develop this further with the national strategy staff working with HEIs, for example, providing courses of different lengths that have a firm subject base. This would require a change in the briefs of the strategies but would build on the work already done.

25. The recently established London Mathematics Centre, based at the Institute of Education, University of London, is running an expanding 3 year pilot on providing upper secondary and FE teachers with some sustained CPD. It has based its work with its schools and colleges on a 10 day model, with teachers working together for 6 days to be stimulated by experts, to use ICT for mathematics and to begin work on half-formed starter ideas for use in classrooms. 4 days are protected back in their schools to allow them to work alongside colleagues to reflect on the work and to develop and refine materials.

26. The residential Easter conferences of the Association of Teachers of Mathematics (ATM) and the MA have been much appreciated over the years and a very significant proportion attend regularly because of the opportunities for sustained reflection and discussion away from the classroom. The professional officers of these two associations organise training days, which are advertised through the journals and also directly to schools. Local branches are important vehicles for development in some parts of the country, and they usually bring together teachers from more than one phase. The associations have been instrumental in producing booklets to engage teachers in reflecting on their own practice. A recent example is 'Thinkers' from the ATM, which is a collection of activities to provoke mathematical thinking, particularly for those learning mathematics from 8 to 18+.

27. The MA diplomas in the 1970s involved a commitment to 40 days over 2 years. The diploma course devised mainly for primary teachers — Diploma in Mathematics Education (DIME) — involved around 150 teachers at its height. Later, a one-term full-time course for teachers of low attaining students was developed. Teachers currently have limited opportunities for such extended study and this must be addressed if their needs are to be met.

28. More recently, teachers have valued their involvement with initial teacher training (ITT), saying how much they themselves gain from being a mentor. Recently 50 mentors were willing to attend a training session on a Saturday morning in Cornwall because of the interest and relevance to what they were doing.

29. It is very clear that a range of developmental opportunities exists across the country, although it is not as broad as in the past. Access to them is, however, variable. Teachers in their second, third and fourth years of teaching, for example, often feel that they are provided with few CPD opportunities relevant to their stage of development. Similarly, the needs of other groups are very particular and not always appropriately catered for: overseas trained teachers, non-specialist

teachers and Advanced Skills Teachers (ASTs), for example.

30. It has been said that teachers who have only been teaching for 8 years or less do not tend to question methodology because they have been working within one of the strategies and feel that methods have been prescribed. How do they decide what is the best way to teach something? More generally, how do they make choices about what they do; and how do they make decisions in lessons based on the responses of their students? These fundamental issues are not often talked about and worked on in 1 day courses, which deal with a particular aspect of the curriculum or with attainment in particular tests or examinations.

31. It is also important to recognise the needs of other adults who work in classrooms, such as teaching assistants (TAs) and higher level teaching assistants (HLTAs). Practitioners who work with the youngest children are frequently nervous about mathematics, have less access to CPD than primary teachers and normally have to go on courses in their own time. They are also relatively poorly paid.

32. Universities play an important part in CPD not only through courses based on educational research but also because of the involvement of research mathematicians. The Royal Institution Masterclasses provide good examples of universities being involved with schools, and teachers being encouraged to work with lecturers to challenge the young people mathematically. The Open University has a long history of providing a range of opportunities for teachers to work at a distance on both subject and pedagogical knowledge. However, Adrian Smith's report expressed concern that there is all too little interaction between HEIs and schools and colleges. This needs to be addressed in the new structure.

33. In any future structure, there has to be clarity of what constitutes recognisable CPD – ongoing development, improving subject knowledge, building leadership capacity, putting new ideas into practice, and so on – and there has to be a wider range than currently exists to meet the needs of teachers at different stages of their careers. The words 'provision' and 'offer' suggest a top-down model, but there have to be opportunities for teachers themselves to determine the nature of the developmental process in which they are engaged.

34. As well as courses that are perceived to be required nationally, there is a need to create a culture where teachers are encouraged to take responsibility for their own professional development throughout their careers. This must be linked to a rigorous appraisal system where work is evaluated and targets set for the future, and which bears in mind the needs of the

teachers and the nurseries, schools or colleges where they work. This implies the need for consistency on the part of the head teachers and other managers. There needs to be clarification about entitlement and contractual obligations and an acceptance that entitlement brings with it responsibilities. There also needs to be clarification about what is meant by the 'continuing' nature of CPD.

Time and access issues

35. All those interviewed from schools and colleges spoke of the frustration of not having time to reflect on what had taken place on the courses and to develop further materials/ideas; similarly it was difficult to find time to disseminate to colleagues back in the school or college. There is, therefore, a need to take this seriously and build in time for these activities. This has a cost implication that must be taken equally seriously.

36. The DfES has been encouraging creative thinking by senior managers to raise attainment in secondary schools through the Leadership Incentive Grant (LIG). This grant has focused particularly on the use of time and related workforce reform schemes. This could usefully be extended to all schools and colleges so that time can be created to discuss issues such as the quality of teaching and learning (rather than administration), and also to disseminate information to colleagues. There is a need for a network to help to spread good practice in terms of these broader management issues.

37. Many have reported that a good way to maximise the impact on a school or college is to send two teachers on a course. Others have found that inviting colleagues to observe lessons where they have been trying to put into practice what they have learned or developed has been particularly effective with part-time colleagues who can rarely attend departmental meetings. Secondary and FE teachers would welcome more courses in the summer term when they have fewer teaching commitments.

38. Generally teachers are aware of local provision, though it is anticipated that it will be easier to be informed about a wider range of courses through the NCETM and localised structure, with a user-friendly website and a very good search engine.

39. With the current shortage of specialist teachers, supply cover for teachers who are attending a course causes problems in many areas. Consequently, there was a mixed reaction to courses that take place in the school day. Some head teachers and heads of department have said that teachers could be released if supply cover were paid centrally. Others have said that this would not

help; they do not want to use supply cover because of the problems of finding teachers of sufficient quality. There is evidence that some head teachers, particularly in primary schools, do not pass on information about courses because they do not want teachers to be away from school during the day. For this reason teachers need more direct access to information.

40. There is usually a good response to courses run by the national strategies; they are free and funding for supply cover has been given whether teachers go on the courses or not. Some schools are said to have benefited financially from not sending teachers on the courses! This must be avoided in future.

41. Many teachers feel guilty about missing their classes and would rather not be out in the daytime. Others disagree, saying that their 'own time' should be protected, and this is consistent with edicts on workforce reform. Generally, there is concern about removing scarce resources from the classroom on too many occasions. Some LEAs with particular problems of supply cover have provided courses in twilight sessions or on Saturdays and paid the teachers for attendance at these courses in their own time.

42. Being away from your class is very hard in primary schools, especially small ones. It is harder still in the Foundation Stage. Even in a four-teacher school it is hard to have many half or full days away from the class. Some small schools have been imaginative and have bought in very specific help while a teacher is away for a few days on a course. This has involved an art or music specialist, for example, to cover areas of the curriculum in which the school's own teachers are not specialists. This is a very good example of forward planning that ensures that the students do not have a poorer deal because their usual teacher is absent. The NCETM could spread knowledge of creative overall school management practice that enables staff to participate in CPD.

43. It is vital to ensure that good opportunities are provided that do not involve expensive and time-consuming travel. In general, teachers are willing to travel for about an hour in each direction for a one day course, but ease of travel in the area is the most important factor. If teachers have to travel by car, they want to be confident that they can park easily. We also know that teachers are prepared to travel longer distances when they are confident that the quality will be high and that they will gain from the time spent on the course. This is particularly true for courses of more than 1 day.

44. Clearly, there has to be flexibility in order to help particular institutions – and this again emphasises the need for knowledge of the entitlement of

individuals to CPD. Local knowledge of the geography of the region is also important.

Remuneration

45. The provision of time was more important than money for many who dismissed the suggestion that teachers be paid for attendance at courses. However, as noted above, there was strong support for teachers to be paid for attendance 'in their own time', such as during evenings, Saturdays and holidays.

46. FE teachers expressed the need for paid cover. Many find it hard, if not impossible, to go out on training because cover is often not available to replace them. Merging classes rarely works in FE as classes tend to be large.

47. Part-time teachers should be paid to attend meetings which are being held when they are normally not in the school or college. Some have to make special arrangements, such as child care. Many currently refuse to attend meetings outside their agreed times because of these problems.

Accreditation

48. Most teachers felt that some sort of accreditation should be given for courses successfully completed, but it is acknowledged that there must be some accountability. Attendance at a course or involvement in a more personalised development opportunity should lead to time being given for action afterwards, and also for a 'report' to be given, say, a year later, about the impact and effectiveness of the experience. It is not sufficient to simply record attendance. Accreditation should therefore be awarded for courses that have been successfully completed, reflected on and acted upon.

49. This all begs the question raised earlier about what constitutes recognisable CPD. There also needs to be clarification about entitlement and contractual obligations and the links to the appraisal system. Learning and development undertaken simply because it is rewarded or a contractual obligation is unlikely to become embedded or be sustained.

50. The NCETM would need to work with the Teacher Training Agency (TTA) and the General Teaching Council of England (GTC), who are looking at verifying CPD and producing some national accreditation schemes. If teachers have an entitlement to continuing CPD, they therefore, by implication, have access to funding. Everyone needs to be clear what this entitlement is.

Quality assurance

51. Inspection evidence highlights the variation in quality of local provision. Schools say that they are bombarded by information about courses through the post but frequently do not have enough knowledge of the track record of independent providers. Some feel to have been let down by the lack of information in the flyer. Sometimes there has not been sufficient progression from one course to the next; for example, on courses about accelerated learning there has not been much progression from the first to a subsequent course. Attendance has then been considered to have been a waste of time and this has put teachers off applying for other courses.

52. Some form of kite marking is recommended as it is important that within the new structure the quality of CPD courses offered is monitored. It is assumed that the providers would receive a kite mark and then be responsible for their own quality improvement processes, with occasional external verification.

53. Potential and newly qualified teachers are attracted by a career which takes CPD seriously. The provision of, and entitlement to, high quality CPD is likely to encourage both the recruitment and retention of teachers.

A preferred model

54. It is important to be reminded of the remit for the NCETM and its associated infrastructure. This remit is to improve the subject and pedagogical knowledge of teachers so that their teaching motivates students to achieve their maximum potential in mathematics. It is hoped that this would eventually lead to an increase in the number of students wishing to continue with the study of mathematics post-16 than is currently the case. The infrastructure is concerned with the provision of a high quality of CPD for teachers of mathematics wherever they live and work, and whatever the size and type of institution they work in.

55. Although some respondents have expressed concern that the NCETM might be adding a layer of bureaucracy and absorbing a high proportion of the money, most agree that there is a need for a NCETM 'at the centre' and that this will have a vital strategic and co-ordinating role. However, in thinking about such structures it is important to start with the teachers and work back to 'the centre'. The majority of the money available has to be spent on the teachers and not on the infrastructure.

56. Those involved in running the NCETM and the national infrastructure will need to evaluate the impact of the centre on practice in classrooms or wherever training in mathematics takes place.

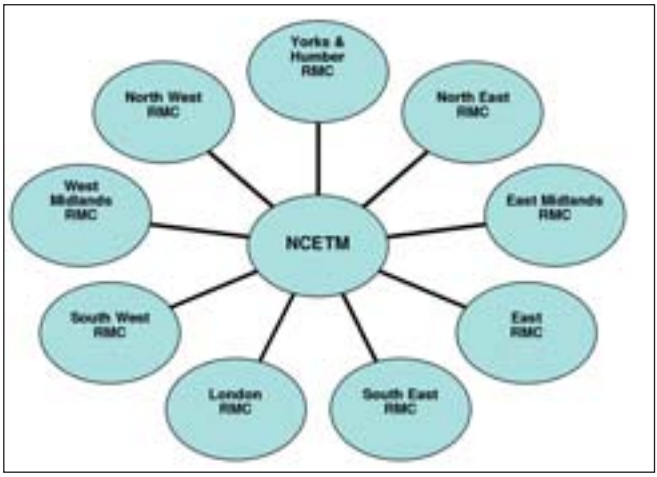
57. The 'local offer' has to be sufficiently local for the majority of teachers to become involved. LEAs provide a good local base in most cases, breaking into smaller areas where necessary. The main activities which take place at a local level involve single institutions, or small consortia of schools, sixth form colleges and colleges of FE, as well as LEAs, HEIs, local employers and Regional Development Agencies (RDAs).

58. The key question is what needs to be set up between the many local networks and the NCETM to bring about the most effective structure.

A regional structure

59. Currently most other organisations are based on the nine Government regions, including the National Strategies, RDAs, the local Learning and Skills Councils (LSCs) and the Open University's networks to support students. In the short term, there would seem to be no reason to move away from this model.

60. It is recommended that there is a middle structure, between the schools and colleges and the NCETM, based on these nine regions. This would involve the setting up of a Regional Mathematics Centre (RMC) in each of the nine regions. Each would operate



as a 'hub' in the centre of the region linking to schools and colleges, LEAs, the national strategies, the PNS's learning networks, specialist schools, the MEI Further Mathematics networks, and others.

61. The above diagram outlines the proposed national structure (it does not show the institutional links within the regions referred to in the previous paragraph).

62. The model can be viewed in two ways – top-down and bottom-up. National priorities and needs would be determined at the NCETM through the Chief Adviser for Mathematics using inspection, national test and examination evidence. Key players in addition to the Chief Adviser and the Director of the NCETM would be the directors of the national strategies and the HMI Specialist Adviser on Mathematics in Ofsted. All would need to work together strategically.

63. The NCETM has a key role in determining the national landscape for CPD, working with other agencies. For example, the role of the National Strategies is changing as national priorities change, and their expertise and structure could be usefully employed in a broader developmental remit. The NCETM will also foster international links and collaborative exchanges in relation to research and development in mathematics education.

64. The NCETM would devolve responsibility to the RMCs, which in turn would co-ordinate the local offer and identify gaps. Because the nine regions are inevitably large it is recommended that there be local network co-ordinators, particularly in large urban areas (there could be up

to 40 of these). In the North West, for example, one co-ordinator could work in the Greater Manchester area, another in Merseyside, and another in Lancashire and Cumbria. The needs would have to be worked out in each region based on local knowledge.

65. To ensure effective working there must be a strong two-way flow of information, from the centre outward and from the local initiatives, and even single schools and colleges, to the centre. It is important for teachers to have access to the centre, and it is important for the centre to hear from teachers about their needs, the quality of their training and so on.

The function of the Regional Mathematics Centres

66. The function of the RMCs would be to co-ordinate and promote regional CPD activities for teachers of mathematics and to ensure that teachers are actively involved at a local level. The RMCs would mediate with the NCETM to provide a coherent regional provision throughout the country. They would also have responsibility to ensure that national needs are met at regional and more local levels. This would include imparting subject knowledge and pedagogy to those who need it and developing mathematical leadership and management capabilities to improve the quality of the teaching of mathematics in each region.
67. The RMCs would have a vital role in identifying gaps in provision, and in fostering collaborations which do not exist at present, for example with schools working alongside FE and sixth form colleges in the promotion and co-ordination of a national provision for Further Mathematics A-Level.

68. It would probably be cost effective to use universities with known expertise and good library, ICT and conferencing facilities but it would also be valuable if some schools or colleges (for example, specialist schools for mathematics with known good practice) were appointed to co-host some RMCs. Universities are often at the cutting edge of research and development and good at meeting future graduate training needs, including the supply of well-qualified teachers of mathematics.

69. If RMCs were to be 'virtual' sites rather than ones to be visited, the position of the RMCs would be less important, though it would be helpful if teachers and lecturers could identify with their regional centre in some way.

Teachers' hopes for the new infrastructure

70. The CPD on offer in each region must cater for the professional development needs of the wide

spectrum of those involved in teaching mathematics from under 5s to post-16.

71. The NCETM must clarify the entitlement, and contractual obligation, of individuals to life-long, continuing CPD. Schools and colleges hold the budgets for CPD but monies come from many sources, for example, LEAs, the national strategies, initiatives such as EAZs and LIG, and, in FE and sixth form colleges, from the Learning and Skills Council (LSC). The NCETM will need to develop an overview of the funding and ensure that mathematics has its appropriate share.

72. It is not anticipated that the NCETM and RMCs would be providers of training and development, but that they should bring together and co-ordinate the activities of a wide range of stakeholders in support of all aspects of the teaching and learning of mathematics and wider issues related to raising the profile of the subject and public awareness of its importance in the modern world. There is a need to address two important perceptions; firstly, the difficulty of mathematics compared with other subjects, and secondly, the lack of importance given to mathematical skills. It is important to raise awareness of computer-rich workplaces and the obsolescence of craft skills alongside the emergence of techno-mathematics.

73. ACME hopes that, once established, the NCETM and RMCs will undertake the following roles:

- co-ordinate policies and set standards;
- provide easily accessible information about courses and materials through a very good website and search engine;
- ensure that courses are clearly advertised and are of a high quality;
- encourage cross-phase activities that address issues of transition;
- make educational research evidence accessible to teachers in all phases so that it can inform their teaching;
- badge resources in some way and use teachers to review them and comment on their value. These resources include software, textbooks, mathematics websites, posters and models, and badging them will help teachers to be better informed when making decisions about purchases;
- provide web links to courses and vice versa;
- raise teachers' awareness of professional journals, such as those produced by the ATM and the MA and encourage membership of such organisations, possibly by offering free membership for 1 or 2 years to new teachers;
- produce newsletters (as produced by some LEAs), which will provide regular updates on curriculum and qualifications development and give information across all phases;

- keep abreast of developments such as the London Mathematics Centre and evaluations carried out on such projects, making recommendations for expansion if appropriate;
- provide a discussion site for teachers to share and develop ideas and comment on good practice;
- actively engage with teachers and use them constructively in a two-way dialogue;
- provide a national help-line for teachers and providers;
- develop an overview of the funding that is devolved to schools and colleges and ensure that mathematics has its appropriate share.

Recommendations

74. In view of the responses received, it is recommended that:

- the NCETM should set up Regional Mathematics Centres (RMCs) based on the nine Government regions in England, and then, within the RMCs, create local networks with co-ordinators;

- as a matter of priority, the NCETM should work over the 3 years to develop a sustainable model for CPD in mathematics;

- the NCETM and RMCs should have co-ordinating (rather than providing) roles, linking the many existing networks and ensuring that the provision is of the highest quality. They must develop strategies to assess whether there has been a positive impact on the teachers and their students;

- the NCETM should develop a strategic role in relation to CPD by working with the Chief Adviser for Mathematics and others in key national roles, developing priorities that bear in mind the personal development needs of the teachers as well as those of the schools and colleges where they work, and those agreed nationally;

- the range of CPD opportunities should be broadened, for example by considering the types and lengths of professional development courses available in the 1970s and 1980s. The NCETM should identify gaps in current provision and stimulate others to plug these gaps;

- a culture should be created where teachers accept some responsibility for their own development and which encourages them to be more proactive in this, while working within their school or college systems;

- the NCETM should clearly define what is meant by 'continuing' professional development and clarify what is meant by teachers' entitlement to this. Consideration will need to be given to how time can be provided for reflection, for actions and for dissemination to colleagues after a course or other CPD experience and how to engage more people in subject-specific CPD. Related funding issues need to be considered and recommendations made;

- the NCETM should work with others, such as the Teacher Training Agency, the General Teaching Council and the National College for School Leadership, to ensure that head teachers and senior managers in schools and colleges understand the particular need for subject-specific CPD in mathematics and are imaginative in finding ways of creating time for

this to occur. There is also a need to look at the management of mathematics teaching across many FE colleges;

- the new structure should encourage greater interaction between Higher Education Institutes and schools and colleges.

Some threats or risks

75. A financially well-supported national structure will not in itself ensure that students have a better deal in their classrooms and that they are motivated to learn mathematics more effectively than in the past. Those who are entrusted to run the NCETM and the regional infrastructure will need to make it clear how they will know that there has been a positive impact on teachers and their students.

76. There are a lot of initiatives, and pressure on schools to respond to them; schools frequently belong to many networks (and funding streams) of a general nature; for example, EAZs, EiC, and LIG collaboratives. There are pressures for teachers to engage in whole-school training and development at the expense of subject specific work. Both are important but the question is how to achieve an appropriate balance.

77. Money earmarked for mathematics CPD does not always get spent on that. Unless this is addressed mathematics is unlikely to receive its appropriate share. Teachers need to be aware of both their entitlement to CPD and the funding available to undertake it. Money could also be wasted if CPD is not monitored sufficiently and provision remains *ad hoc*.

78. The NCETM and the regional infrastructure should provide joined-up thinking within the mathematics community. There is also a need for the initiatives coming from the DfES, and others, to be joined up otherwise there will be confusion or conflicts in schools and colleges.

79. Schools and colleges have been part of a culture of competition in recent years. There is a need for co-operation and sharing. It would be helpful if everyone, including the DfES, encouraged this as widely as possible.

80. HMI reports have repeatedly spoken about the impact of the subject leader on the quality of provision. Training and development for those in these key positions are essential, but even large LEAs cannot regularly provide courses for new secondary heads of department. The NCETM and a local structure must help with this or opportunities to work with keen new post-holders will be lost.

81. The Smith report highlighted many issues of concern that had been

raised in the Cockcroft report[5] 22 years earlier. The fact that these are still issues is a reminder that solutions are not easy and that quick fixes do not bring about the necessary fundamental changes that are required in some areas. The Smith report highlighted the failure of the curriculum to excite students post-14. If this issue is not addressed from 4–19, and teachers are not excited by the mathematics they are teaching, progress will be very limited.

5 Cockroft, W.H. 1982. *Mathematics Counts. Report of the Committee of Inquiry into the teaching of mathematics in schools*. London: HMSO.

List of Contributors

This ACME feasibility study was led by two independent education consultants (Kathleen Cross, retired HMI, and Jack Abramsky), was steered by two ACME Members (Colin Matthews and Sue Sanders) and was project managed by the ACME Secretariat at the Royal Society (Nick von Behr). A final report, endorsed by the whole Committee, was submitted to the DfES in May 2005. ACME would like to thank all those who contributed to the study by completing questionnaires, attending meetings and providing essential data for analysis and synthesis into the final report. Below are the names of the organisations/institutions to which the individuals belonged who provided this information.

Adult Basic Education Service, North Tyneside
Association of Colleges
Association of Colleges in the Eastern Region
Association of Teachers of Mathematics
Barrow Hedges Primary School, Sutton
Beddington Infants School, Sutton
British Society for Research in the Learning of Mathematics
Camborne Science and Community College
Cambridgeshire County Council
Cheadle Sixth Form College
Cornwall LEA
London Borough of Croydon
Darlington College of Technology
DfES CPD Regional Advisers
DfES Standards Unit
Edinburgh Mathematical Society
Fairchilds School, Croydon
Harrow Advisory Service
Heads of Departments of Mathematics
Higher Education Academy, (Mathematics, Statistics and Operational Research Learning and Teaching Support Network)
London Borough of Hillingdon
Hills Road Sixth Form College, Cambridge
HK Associates
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Institute of Mathematics and its Applications
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National Association of Mathematics Advisers
National Association for Numeracy and Mathematics in Colleges
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The Royal Statistical Society
Royal Statistical Society Centre for Statistical Education
Rywfield Primary School, Hillingdon
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SETNET
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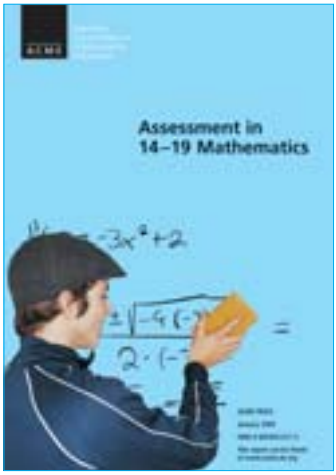

Continuing Professional Development for teachers of mathematics
(15 page report of ACME's first self-initiated project, December 2002, 2 page summary also available)*

Teaching and learning geometry pre-19
(88 page report of a Royal Society/JMC working group, July 2001, 3 page summary also available)**

Mathematics education pre-19
(4 page statement by the Royal Society, May 1998)

Teaching and learning algebra pre-19
(72 page report of a Royal Society/JMC working group, July 1997, 4 page summary also available)**

* Full text of this report can be found on ACME's webpages at www.acme-uk.org
**Full text of these reports can be found on the Royal Society's website at www.royalsoc.ac.uk

Copies of these publications can be obtained by sending a self-addressed and stamped envelope to:
Education Team, The Royal Society,
6–9 Carlton House Terrace, London SW1Y 5AG

For further information about the Advisory Committee on Mathematics Education:

ACME
The Royal Society
6–9 Carlton House Terrace
London SW1Y 5AG
tel: +44 (0)20 7451 2571
fax: +44 (0)20 7451 2693
email: acme@royalsoc.ac.uk
www.acme-uk.org

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