



Advisory  
Committee on  
Mathematics  
Education

# Continuing Professional Development for teachers of mathematics



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# Continuing Professional Development for teachers of mathematics

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## Preparation of this report

This report has been prepared by the Advisory Committee on Mathematics Education (ACME).

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# Executive Summary

The Government recognises that there is an urgent need to improve the mathematical skills of the general population. There are concerns about both numbers and quality. In particular, we note:

- the poor uptake of school pupils continuing mathematics through to the age of 19 and beyond;
- the reduced numbers of students qualifying for Higher Education courses in numerate disciplines, especially science and engineering and, this year, in mathematics; and
- the under-supply of appropriately qualified mathematics teachers, which is exacerbated by the high demand for the skills of mathematically qualified graduates.

These concerns are linked, in that the teachers of tomorrow are drawn from the pupils and students of today. The Advisory Committee on Mathematics Education (ACME) believes that radical steps need to be taken now in order to break into this closed loop. It contends that one of the most effective ways to do so and to raise the quality of mathematical provision in schools would be to expand substantially Continuing Professional Development (CPD) for teachers of mathematics. It believes this would revitalise skills throughout teaching careers, and would re-enthuse and help retain existing teachers of mathematics.

## Recommendations

After consultation with both the mathematics community and bodies involved in the professional development of teachers, ACME has now produced this, its first self-initiated report, on CPD for teachers of mathematics, which makes the following recommendations:-

1. We recommend that the Government should initiate urgently the process of developing and funding a long-term programme of CPD for teachers of mathematics that can meet their needs at various stages of their careers. To help launch this initiative, the Government should first: obtain relevant data on both the number of teachers of mathematics needed over the next 10 years and the qualifications of existing teachers; commission a survey of current CPD providers in mathematics; and convene a series of seminars to examine international best practice in CPD for teachers of mathematics.
2. We recommend that CPD for teachers of mathematics should contain an element of broadening and deepening of mathematical knowledge. This should complement an appreciation of how pupils learn, and a comparison of varied methods of teaching, mathematics. The weighting of each of these components will vary from course to course according to teachers' and schools' needs and goals. A survey of teachers of mathematics to elicit their views on CPD would help to determine these needs fully.
3. We recommend that part of any CPD programme should be structured so as to allow opportunities to relate theory to practice in the classroom, and to provide time for informed and collaborative reflection with peers and with those with appropriate expertise.
4. We recommend that teachers of mathematics should be expected to engage in CPD throughout their working careers. This implies an entitlement to time and funds, alongside a system of accountability and rewards.
5. We recommend that teachers of mathematics must be given an allocation of time and resources to enable coherent planning and development to take place at an institutional level. There is currently a crisis in mathematics teaching, and some funding tied to CPD for teachers of mathematics must be provided directly to schools and colleges. The Government should commission a study to quantify both teacher in- and out-of-school training entitlement and the resource implications for schools of making such an allocation.
6. We recommend that a network of Local Mathematics Centres (LMCs) should be developed to encourage the growth of a community of teachers of mathematics across all phases and to provide a source of expert advice, resources and information. The Government should commission a feasibility study of how LMCs might function and then set up a pilot centre involving teachers, Local Education Authority staff and academics from mathematics and education departments.
7. We recommend that a National Academy for Teachers of Mathematics should be established to have a strategic overview of CPD at a national level and to coordinate its operation locally. The Government should commission a feasibility study to set out a range of options with costings and then seek private sponsors for funding.
8. We recommend that some CPD funding should be made available directly to teachers of mathematics to enable them to undertake substantial professional development according to their individual needs and goals.

# 1 Introduction

We wish to clarify our terminology. First, we note that there are what we will call ‘training’ programmes. These are specifically targeted and might last for a day or a few days. They might concern, for example, the implementation of a new assessment scheme or curriculum, or understanding some new legislation which has implications in schools or colleges. Next, there are what we will term ‘professional development’ courses such as a short course on using the graphics calculator to introduce linear functions and equations or a short course on some branch of statistics. 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 (e.g. a 20-day mathematics course spread over one year, followed by a course in leadership, a masters course, or several courses on the use of different software for teaching mathematics culminating in an in-depth study of IT and geometry). 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 a mathematics co-ordinator or others with expertise, with the aim of enhancing the knowledge, skills and enthusiasm of the teacher.

## 1.1 Rationale for ACME’s CPD project

The Government recognises the importance of improving the overall mathematical expertise of the general population. In his significant report to HM Treasury, Sir Gareth Roberts (Roberts 2002) noted the insufficient numbers applying to take degrees in mathematics and the major numerate disciplines, and the worrying drop in the proportion of pupils taking mathematics A2 following the introduction of Curriculum 2000. Added to these problems is the existing acute shortage of mathematics teachers and the fact that the under-supply of numerate graduates makes it difficult to recruit new teachers of mathematics with good quality mathematical backgrounds<sup>1</sup>. A closed loop has been created, with not enough of today’s pupils and students turning into tomorrow’s mathematics teachers.

After taking evidence and following broad consultation within the mathematics community (see Annex 1), The Advisory Committee on Mathematics Education (ACME) believes that the most effective

way to break into this closed loop is to offer a substantial programme of CPD aimed specifically at existing teachers of mathematics in primary and secondary schools. Whilst we believe CPD is important for all teachers in all subjects and whilst we recognise that the DfES is moving toward a strategy for increased teacher professionalism, nevertheless we stress that the current state of mathematics throughout the system makes a large-scale, coherent, carefully focused programme of CPD in mathematics a matter of urgency and national priority.

Such a programme, which should have equal emphasis on teachers of mathematics with or without a strong mathematics qualification, would improve the teaching of mathematics, re-enthuse existing teachers of mathematics and support and develop them throughout their teaching careers. This re-invigoration will improve their retention in the profession. In addition, we anticipate that a programme of CPD will encourage and assist those teachers who have been recruited from other subjects to teach some mathematics, and will facilitate the return to the profession of individuals from the pool of non-active mathematics teachers.

Thus a successful CPD programme would yield a more motivated and enthusiastic teaching force in mathematics as well as having the potential to increase its size and expertise. Such improvements would, in turn, help to alleviate the other problems noted in the preceding paragraphs.

## 1.2 The need for CPD in mathematics teaching

There is a natural need for CPD among all Newly Qualified Teachers (NQTs), since it is impossible for Initial Teacher Training (ITT) to provide future teachers with all they should know about the subject they will teach, how pupils learn it and how to teach it effectively; and there is a need for CPD for more experienced teachers in all subjects.

However, the technical nature of mathematics and the subtle links within it mean that there is a special requirement for CPD among those who teach mathematics, both the newly qualified and the high proportion of experienced teachers who do not have an appropriate mathematics background and whose understanding of the subject itself may therefore be limited.

<sup>1</sup> DfES statistics from January 2002 show mathematics as the top shortage subject with 17% of all classroom teacher vacancies in maintained secondary schools; while DfES statistics from 1996 (the most recent available) show that only 40% of teachers of mathematics in maintained secondary schools had a degree in mathematics.

In addition to these particular cases, it is vitally important for the health of the profession that experienced and well-qualified mathematics teachers are also given the opportunity to revitalise their skills and to renew their enthusiasm for their subject. Further, teachers of mathematics need not only to deliver curricula, but also to adapt them to pupils' needs, to customise curricula and assessment frameworks to their practice, to deal with new materials and advances in technology, and to learn from advances in research on pupil learning and on teaching practice in mathematics. Indeed, a mathematics teacher's education should be seen as a professional continuum, a career-long process.

### 1.3 The present situation

A review of initiatives over the past three decades was compiled by ACME to give a background to the types of training and professional development which were previously available (including noting the cultural expectations of the profession at the time, whether participation was voluntary or directed, and their length and depth) and those in place in 2001/02 (see Annex 2).

It is clear from this review that there has been a shift in provision away from longer accredited courses towards short course provision, mainly centrally managed and delivered and largely geared to lower grades. The types of professional development now on offer range from day courses (usually around national initiatives) to extended programmes leading to higher degrees, with

financial support ranging from full-cost (mainly for the former) to little or nothing for the latter. The Government has put in place well-resourced training for the implementation of the National Numeracy Strategy (NNS) and Key Stage 3 (KS3) Strategy. Primary or KS3 training is common to all teachers in that sector who have had the chance to attend so far. This training has generally been well received and has had the effect of boosting some professional development for all teachers of mathematics within schools. Additionally the Government has put in place an array of initiatives for supporting mathematics teachers. However, we are aware of an urgent need to take stock and interconnect these developments, to plug gaps in provision, and to seek to identify what is effective for different groups of teachers in order to plan sustained portfolios of CPD that will meet the diverse needs of teachers of mathematics.

**We recommend that the Government should initiate urgently the process of developing and funding a long-term programme of CPD for teachers of mathematics that can meet their needs at various stages of their careers. To help launch this initiative, the Government should first: obtain relevant data on both the number of teachers of mathematics needed over the next 10 years and the qualifications of existing teachers; commission a survey of current CPD providers in mathematics; and convene a series of seminars to examine international best practice in CPD for teachers of mathematics.**

## 2 A CPD programme for teachers of mathematics

In this section we outline the desirable ingredients of a CPD programme that we envisage will meet the challenges set out earlier.

### 2.1 Key components of a well-planned CPD programme

We wish to see more professional development for teachers of mathematics that seeks to broaden and deepen mathematical knowledge and to integrate this with study of pupils' learning and with teaching approaches. The notion of 'unpacking' mathematics to focus on the processes of doing mathematics rather than only on learning outcomes is crucial. Some courses may start with introducing mathematical ideas from the school curriculum and ask teachers to analyse those ideas from the learners' perspective; others may use pupils' mathematical thinking as a springboard to motivate the teachers' learning of mathematics; still others might begin with elements of teaching practice or curricula and move towards a consideration of their potential influence on progressing mathematical thinking.

It is essential that teachers have sufficient subject knowledge to challenge and develop the full range of pupils whom they teach, otherwise pupils will not gain the full benefits of their education. Broadening and deepening mathematical knowledge and understanding means teachers can become increasingly aware of key ideas, new ways to promote mathematical reasoning as appropriate to diverse pupils, different representations and links within mathematics, as well as links to other subjects where mathematics plays a role. It also encourages a positive attitude to mathematics among teachers, which is crucial to their continued enthusiasm for the subject.

But for teachers of mathematics an important part of broadening their knowledge is appreciating how pupils learn mathematics and the potential obstacles to learning that they are likely to face. Improving awareness of the different methods of teaching mathematics allows teachers to become ever better at teaching through a process of reflection and self-critique. Finally, teachers should have the opportunity to reflect upon different approaches to the mathematics curriculum: how it is structured in terms of progression in any one topic area, the links made between topics and the way the topics are introduced and revisited in different contexts.

**We recommend that all CPD for teachers of mathematics should contain an element of broadening and deepening of mathematical**

**knowledge. This should complement an appreciation of how pupils learn, and a comparison of varied methods of teaching, mathematics. The weighting of each of these components will vary from course to course according to teachers' and schools' needs and goals. A survey of teachers of mathematics to elicit their views on CPD would help to determine these needs fully.**

### 2.2 Starting from needs: a coherent programme for a diverse community

Professional development should be differentiated according to the diverse needs of teachers of mathematics. Teachers have different pedagogical skills, mathematical knowledge and experience of teaching and aspirations. CPD should be sufficiently flexible to allow teachers to recognise and work on their different needs, and should provide a structure within which teachers can identify their needs and how they might be met. Thus a range of provision must be available nationally and locally at different stages of teachers' professional careers or different points in their mathematical development.

We highlight some distinct categories of teachers of mathematics with potentially differing CPD needs (see Annex 3 for a series of fictional case studies to illustrate such provision):

1. Primary school mathematics co-ordinators;
2. Primary schoolteachers generally;
3. Secondary school heads of mathematics or aspiring heads of mathematics;
4. Secondary school specialist mathematics teachers;
5. Secondary school non-specialist mathematics teachers (defined as those teaching mathematics whose main subject specialism is not mathematics or a closely aligned discipline); and
6. Further Education lecturers in mathematics and numeracy.

In addition, there will be other groups of teachers with an involvement in mathematics teaching, e.g. those working with pupils with special needs. We recognise that within each of these categories there remains enormous variation in teachers' backgrounds, goals and needs. We would envisage, for example, the following provision, some or all of which might include award-bearing courses: courses for NQTs; courses for those in their first year of holding a co-ordinating/leading post; courses for each group in their second or third year of teaching or holding a co-ordinating/leading post; a more diverse range of focused courses for teachers with



more than 5 years' experience in their current role. Additionally, there is a need for provision concentrating on particular areas of mathematics (for example the present need for statistics and data handling), gifted pupils or those with special needs, new initiatives in curricula or in resources, and integration of Information and Communications Technology (ICT).

All of the evidence suggests that short courses (half/one/two day) are optimally effective when there is time for teachers to reflect on what has been learnt, to seek the best ways of implementing the ideas and methods in the classroom and to reflect on these practices in an informed way. Short-term training is fuelled by short-term issues, such as how to cope with new assessment demands. It does not necessarily build up into general professional expertise (to include, for example, understanding of the complexity of and interconnections between mathematical ideas and their representations, how these ideas might be taught and what the implications for learning are). Time for reflection and for trialling in the classroom and discussion of follow-up actions and further developments are essential for sustained professional development of teaching skills. We would recommend that within CPD there should be opportunities for teachers to meet with peers and those with appropriate expertise to discuss theory and practice as a basis for reflection and a starting point to trial ideas in their classrooms. Additionally, teachers need opportunities to reflect on and critique curricular materials and methods. This enables development of practice rather than reinforcement of current methods. For this to be achieved, support is needed from those with a view, either of mathematics or of the teaching and learning of mathematics, which is wider than delivery of immediate curriculum goals. Reflection opportunities that involve discussion or writing about iterative changes to activities or lessons can be valuable.

Thus we envisage that part of a CPD programme should be personalised, to address teachers' needs and support them in developing their own versions of theories or understanding of mathematics and mathematics teaching, and part should be generalised, so that teachers can place their theories and actions within a wider perspective, but also see how they might

influence their own practice in the classroom or school. It is through this interchange of new ideas with practice that teachers' development can be sustained over time.

**We recommend that part of any CPD programme should be structured so as to allow opportunities to relate theory to practice in the classroom, and to provide time for informed and collaborative reflection with peers and with those with appropriate expertise.**

### 2.3 Entitlement, accountability and rewards

We believe that teachers of mathematics should have an expectation and a responsibility to engage in CPD, which will support them throughout their working careers. This must involve a requirement to participate in CPD, an entitlement to time and funds alongside a system of accountability and rewards. However, in order that CPD becomes an integral part of the culture of teaching, a coherent infrastructure needs to be set up with adequate funding and support. Our proposals are set out in section 3 of this report.

We envisage it may be necessary to encourage teachers of mathematics to engage in CPD, and to reward in some way those who do so (for example by salary increment). Heads of departments and mathematics co-ordinators will need to take the responsibility, with the support of the senior management of the school, to ensure that their team, and individuals within it, keep up to date and enhance skills and keep abreast of new developments. Performance management may help support and encourage CPD, with teachers being set targets for their own development. Equally, the building up of a CPD Portfolio may be an important part of progression, and the key to higher salaries and promotion. CPD should also include an obligation to share good practice and disseminate ideas within departments, schools and local areas.

**We recommend that teachers of mathematics should be expected to engage in CPD throughout their working careers. This implies an entitlement to time and funds alongside a system of accountability and rewards.**

## 3 A support network for CPD provision

In this section we set out our proposals for putting in place an infrastructure to support CPD for teachers of mathematics.

### 3.1 Within the school or college

Schools and classrooms can be places for teachers as well as pupils to learn. Professional development programmes that engage teachers in reflective practice in their own classrooms should provide the basis for teachers' learning to become generative so that their knowledge and practice continue to grow and evolve. We envisage that this process can be encouraged in three ways.

Firstly, teachers have a great deal to learn from observing other colleagues and from good practitioners in other schools, provided observation is undertaken from an informed standpoint. A system of 'Peer Mentoring' would be beneficial, provided there is appropriate time and support. Peer Mentoring generally should be both supportive and developmental, enabling lesson observation and discussion of teaching practice to become more commonplace in schools and acceptable to teachers. To further discussion and reflection on practice, teachers might also be encouraged to join a national professional subject association. Furthermore, some of these organisations might well be encouraged to develop career structure grades for mathematics teachers as part of their membership.

Secondly, professional development requires the marshalling of substantial resources. One of the critical resources is time. Teachers need frequent and regular opportunities to try out ideas and approaches with their pupils and to discuss their experiences with specialists in mathematics and in the teaching and learning of mathematics, as well as with other mathematics teachers. These opportunities should not be limited to a period of a few weeks or months, but be part of the ongoing culture of professional practice. There is very little non-contact time in schools. Heads of department and mathematics co-ordinators, who are key to the delivery of improvement, often teach a full programme, and so have little in-school time to plan, organise and lead their team. They must be given time to spend working alongside teachers in their team to develop good practice, as well as to manage their departments effectively. Additionally, timetabling constraints often mean that there is little time for team meetings about mathematics. Colleagues need the opportunity to meet together to discuss issues and to share common experiences and good practice. Thus we suggest there must be timetabled time for teams to meet regularly to discuss the teaching of mathematics.

Thirdly, within schools, there is a shortage of money for professional development generally and, in practice, short-term issues take priority. Funding for CPD for teachers of mathematics has to compete with other requests and generally is inadequate to begin to resolve the current concerns for the subject. Generally, outside of the national initiatives, teachers of mathematics receive little CPD and they have access only to training or short professional development courses. Clearly, the mathematics teaching profession will not be able to develop a culture of CPD unless sustained and improved funding is made available. We consider that there is a need for direct funding to each school for this purpose and that some of this should be specifically allocated to heads of department or mathematics co-ordinators to allow them to plan for the CPD of staff within their department.

**We recommend that teachers of mathematics must be given an allocation of time and resources to enable coherent planning and development to take place at an institutional level. There is currently a crisis in mathematics teaching, and some funding tied to CPD for teachers of mathematics must be provided directly to schools and colleges. The Government should commission a study to quantify both teacher in- and out-of-school training entitlement and the resource implications for schools of making such an allocation.**

### 3.2 Setting up a local and a national infrastructure for CPD

Learning in ways that continue to be generative over time is best done in a community of fellow practitioners and learners, and professional development is most effective when it extends beyond the individual teacher. When teachers have opportunities to continue to participate in communities of practice that support their CPD, the effects of CPD can be sustained more easily. Some of this will occur in school communities, but often it is effectively developed in wider communities based in Local Education Authorities (LEAs), around the Education and Mathematics departments in Higher Education Institutes (HEIs) or around professional subject association groups. Creating synergies across all these parts of the mathematics community has the added advantage of engaging as many as possible in facing up to the challenge of providing quality CPD.

We note, however, that there is a shortage of individuals with broad experience and expertise to offer training, support and guidance to teachers of mathematics, and it is a matter of concern that the pool of people with

expertise to provide CPD and offer advice is shrinking. There is scarcity in capacity throughout the system with advisors in LEAs, National Numeracy Advisors, and teachers in HEIs all fully stretched. We therefore foresee a need for a national campaign to encourage the development of this expertise, which could itself form part of a CPD programme. What may be needed, for example, is to set up a cadre of 'expert teachers', similar to 'leading mathematics teachers (LMTs)', who may remain classroom based (alongside traditional 'trainers'), but who could also form a part of a network of local resource centres for teachers of mathematics. These local centres should be cross-phase (primary, secondary, Further Education, and Higher Education) to encourage the development of a community of mathematics teachers in a locality, as well as providing resources and information for schools and teachers.

**We recommend that a network of Local Mathematics Centres (LMCs) should be developed to encourage the growth of a community of teachers of mathematics across all phases and to provide a source of expert advice, resources and information. The Government should commission a feasibility study of how LMCs might function and then set up a pilot centre involving teachers, LEA staff and academics from mathematics and education departments.**

Given the fragmentation, lack of coherence and gaps in CPD provision reported to us and noted above, together with the need to support teachers in engaging with future curricular initiatives, an infrastructure for mathematics CPD must be set up to co-ordinate provision across the country and organise it at a strategic level. We have been impressed by the models of CPD in operation in France through the IREMs (Instituts de Recherche sur l'Enseignement des Mathematiques – literally translated as 'Research Institutes for Mathematics Teaching'), and in Israel

through the Weizmann Institute. In particular, we have noted the impressive ways that teachers, mathematics educators, and mathematicians work together in designing and implementing CPD. We suggest the establishment of an 'academy' for mathematics teaching, a centre of excellence to provide a unique point of reference for all teachers of mathematics regardless of phase or experience, as well as to set out strategic objectives for CPD and champion their implementation. We note that some of these proposals follow similar lines to those for the enhanced teaching of science in schools through the proposed National Centre for Excellence in Science Teaching.

**We recommend that a National Academy for Teachers of Mathematics (NATM) should be established to have a strategic overview of CPD at a national level and to co-ordinate its operation locally. The Government should commission a feasibility study to set out a range of options with costings and then seek private sponsors for funding.**

Finally, while recognising that the Government is already spending heavily on its centrally controlled initiatives at KS3 and on the NNS, we believe it is necessary for the Government to establish and fund some teachers directly (possibly co-ordinated through the NATM) to foster their individual development. Teachers who seek particular expertise should be encouraged and supported in furthering their own professional and academic development in the teaching of mathematics by attending longer courses supported by national bursaries.

**We recommend that some CPD funding should be made available directly to teachers of mathematics to enable them to undertake substantial professional development according to their individual needs and goals.**

## 4 Conclusion

ACME believes that the CPD infrastructure recommended in this report will begin the process of ensuring that professional development is seen as a continuous and integral part of the experience of teachers of mathematics, to which teachers should be entitled at different points in their careers, and for

which they are responsible. Through the network of national, local and school provision proposed, we envisage that the profession of teaching mathematics will grow in stature with benefits for the profession, pupils and society as a whole.

## Annex 1: List of contributors

ACME has consulted the mathematics, teaching and education communities throughout this project, for which it would like to thank the following organisations and individuals.

### Evidence was given to the Committee by:

- Department for Education and Skills (Ellen Crehan, Janet Dallas and Diane Mankelow)
- General Teaching Council for England (Maureen Burns, Head of Policy and Communications and Sarah Stephens, Policy Advisor)
- Key Stage 3 Strategy (Sarah Sharkey)
- National Association of Mathematics Advisors (Gillian Thumpston, Honorary Secretary)
- National Numeracy Strategy (Carole Macintyre)

### Communications were received from:

- Sian Acreman, Blue Gate Fields Junior School, Tower Hamlets
- Mundher Adhami, Cognitive Acceleration in Mathematics Education Project
- Lucy Allen, Institute of Mathematics and its Applications
- Robert Barbour
- Alan Bloomfield, University of Gloucestershire
- Professor Margaret Brown, King's College London
- Dr Colin Campbell, Edinburgh Mathematical Society
- Lynn Churchman, HMI

- Caroline Dawes
- Dr Ruhama Even, Weizmann Institute of Science, Israel
- Geoffrey Faux, Peter Lacey and Barbara Ball, Association of Teachers of Mathematics
- Dr Tony Gardiner, University of Birmingham
- Professor Harvey Goldstein and Mr Gerald Goodall, Royal Statistical Society
- Professor John Howson, Education Data Surveys
- Rosalyn Hyde, Professional Development Officer, and members of The Mathematical Association
- Dr Barbara Jaworski and Dr Anne Watson, University of Oxford
- Dr Sue Johnston-Wilder, The Open University
- Sir Alistair MacFarlane, Chair Royal Society Education Committee
- Roger Porkess, Mathematics in Education and Industry
- Irene Robinson, Manchester Metropolitan University
- Mary Russell, Universities Council for Education of Teachers
- Professor Peter Saunders, London Mathematical Society
- Paul Scruton, Schools Mathematics Project
- Professor Alan Smithers, University of Liverpool
- Dot Sutherland, Senior Mathematics Advisor for North Yorkshire
- Professor David Stirling, Heads of Departments of Mathematics
- Professor Alison Wolf, Institute of Education
- Professor Derek Woodrow, Manchester Metropolitan University

## Annex 2: Professional development currently available for teachers of mathematics

The range of types of professional development now on offer to teachers of mathematics includes:

1. Award-bearing courses run by HEIs;
2. In-school development run by teachers themselves;
3. Courses run by the NNS at primary level;
4. Courses run by the KS3 Strategy for mathematics;
5. In-school development by numeracy or mathematics consultants employed to implement the two government strategies;
6. Demonstration lessons by LMTs or work with Advanced Skills Teachers (ASTs);
7. Courses run by examination boards to update on syllabi or moderate coursework;
8. Conferences and working groups and day courses run by professional subject professional associations;
9. Day or longer courses run by other organisations e.g. Stands for Education, BEAM Education; and
10. Development as part of government initiatives such as Excellence in Cities (EiC) and Education Action Zones.

**1. Award-bearing courses run by HEIs:** these may lead to diplomas, MAs or PhDs and may involve professional associations. The focus varies but is likely to include mathematics, statistics, teaching and learning and associated research. They are often funded by the individual teachers participating and involve part- or full-time study. Long courses have largely disappeared into modular provision, of which usually between one-sixth and one-twelfth is mathematics related. These courses are also in decline. The uptake might be small but they have a high impact on those involved.

**2. In-school development:** each school will have a policy on CPD and a person responsible for co-ordinating and managing mathematics education. There is likely to be a plan for development in mathematics, which includes use of external course and in-school shared development: for example, there may be plans for reciprocal lesson observations by teachers in the school, or scheduled use of meeting time for discussion of key areas of the curriculum. This is available to all teachers but may not always be used productively and is rarely mathematics related. The use of time in schools may be supported by the professional development materials provided by the NNS and KS3 Strategy. Uptake will reach all teachers but impact is variable, depending on the school.

### **3. Courses run by the NNS at primary level:**

consultants in each LEA run nationally prescribed and locally developed courses. A key course is the five-day course, which includes content and pedagogy. Information from the NNS suggests that every primary teacher would be entitled to attend this course at some time. Within each LEA certain courses are for 'intensive' schools (selected by the LEA as being those who would most benefit from support) while some are for all schools. There are short courses run specifically for mathematics co-ordinators.

### **4. Courses run by the KS3 strategy:**

consultants in each LEA run nationally prescribed and locally developed courses. These have included courses for heads of department and KS3 co-ordinators, which include developing skills in leading departments. A four-day course has been run for less experienced teachers of KS3 mathematics which includes content and pedagogy. Forthcoming courses include how to use materials in departmental meetings to ensure discussion of content and pedagogy. Within each LEA certain courses are for 'intensive' schools while some are for all schools. Uptake: some courses have been attended by delegates from almost every maintained school; others have been available to intensive schools only.

### **5. In-school development for numeracy:**

LEA consultants work in 'intensive' schools to help embed ideas from the courses and to develop skills in teaching and planning. They may work with individual teachers, pairs of teachers or provide training sessions for all teachers of mathematics. This work generally embraces content and pedagogy and action planning. This resource is available to intensive schools (approximately one-third at any one time).

### **6. Demonstration lessons by LMTs:**

in primary schools, LMTs are identified within each LEA who will demonstrate lessons in their own schools to teachers from other schools. Advanced skills teachers in both phases will demonstrate lessons and work with teachers in the 'learning' teachers' classrooms.

### **7. Courses run by examination boards:**

these are key sources of information and training at KS4 and 16-19 levels. Examination boards run courses usually focused on changes to syllabi or assessment methods. There is a small percentage uptake of these courses but they influence an opinion forming sector.

**8. Conferences/working seminars run by professional subject associations:** these are usually at weekends or in school holidays. There are also regular local meetings of professional subject associations as well as annual conferences.

**9. Other organisations (including private sector):** these run courses for mathematics teachers, often on aspects of managing the curriculum; assessment; teaching more able or less able pupils; managing behaviour, etc. Few of these are focused on mathematics and pedagogy.

**10. Government initiatives:** there are often cross-subject developments as part of Government initiatives such as the Gifted and Talented strand of the EIC initiative and the transition work as part of Education Action Zones. This may well lead to professional development for those involved.

## Annex 3: Case studies of CPD opportunities that would become available

The following vignettes reflect the opportunities that would become available with the implementation of ACME's CPD recommendations. The individual profiles of types of teacher illustrate different possible scenarios.

### **Parveti is mathematics co-ordinator in a primary school.**

Parveti did a BA (QTS) with a mathematics specialism and has an MA(Ed) which included some mathematics-focused modules.

She is part of a group working at the Local Mathematics Centre working with Special Educational Needs Co-ordinators on an intervention programme for pupils experiencing difficulties with mathematics in year 2. This is funded as a local initiative and her school receives supply cover costs.

She has attended a short course run by the Local Mathematics Centre on 'Working with parents'. As this is a school priority it was funded by the ring-fenced mathematics CPD budget. Now she is leading a whole school initiative on 'Working with parents on mathematics'.

### **Jackson is a newly qualified primary schoolteacher.**

Jackson has a degree in history, which he followed with a Primary PGCE course. He has a Grade 'C' GCSE in mathematics and describes his own mathematics as 'shaky'. However, he appears very confident with the pupils. He is in his first year of teaching and his Career Entry Profile has highlighted consolidation of personal subject knowledge and integration of Information and Communications Technology (ICT) as needing development.

Jackson is attending a five-day course at a Local Mathematics Centre jointly run by the local University and the Local Education Authority (LEA). This is part of his CPD entitlement as a Newly Qualified Teacher (NQT). The course uses ICT to broaden and develop mathematical ideas as well as demonstrating sound pedagogy. It began with two days in the Local Mathematics Centre followed by a four-week gap during which he tried out ideas in his own classroom with support from the mathematics co-ordinator. There was then one day at the Centre to share experiences and receive expert advice on how to progress. After

another three weeks in school there was another day in the Centre for more guided reflection. There will be another Centre-based day towards the end of next term.

The Centre has also set up an email chat room for NQTs and each member of the course can access expert advice by telephone or email.

Jackson's school is also freeing him up for 1 hour per week to observe and work collaboratively with a teacher of the parallel year group who is very good at integrating ICT into her teaching.

### **Lynn is Head of a mathematics department in a comprehensive school.**

Lynn has a good first mathematics degree and an MSc. After a couple of years in industry she did a PGCE and has been a head of department for 5 years.

She is using a teacher bursary to research ways in which other schools manage their programmes for gifted and talented mathematicians of all ages. She is considering registering for a doctoral programme, which is run by her local university in association with the National Academy for Teachers of Mathematics.

She is an active member of a professional subject association and is making a presentation on enhancing the teaching of geometry at the Annual Conference.

### **Khalid is a mathematics teacher in a secondary school.**

Khalid came into teaching through the Graduate Teacher Programme, after 5 years in accountancy. Now in his third year of teaching he wishes to extend his subject knowledge.

He is already teaching an A2 statistics class and has the support of his head of department for one lesson a week. During the weekly departmental meetings he is able to discuss his successes and to ask for advice from more experienced members of staff.

Khalid attends a 10-week part-time (one evening a week) masters module on statistics, which is delivered by the mathematics department of his local university. He is considering adding some education modules in future years.



**Nadia is a PE teacher in a secondary school – she also teaches some mathematics.**

Nadia has a BA in Sports Psychology and is currently in the first year of a new masters degree scheme, which focuses on both mathematics and education. As well as lecturers from the local university and LEA advisers, there are weekend schools at the National Academy for Teachers of Mathematics, which include input from international experts.

Her head of department is working alongside her for one lesson a week as part of a whole school initiative on improving participation by African-Caribbean boys. This is part of a research and development project jointly managed by the Local Mathematics Centre, LEA and the local university, and funded by a charitable trust. Nadia will use this work towards part of her masters degree.

**Mike works in a College of Further Education where he is responsible for Key Skills (Numeracy).**

Mike has found himself teaching mathematics to young people on a number of programmes including the GNVQ manufacturing strand, even though he was originally employed as a science tutor. He feels competent with the skills element of his teaching but is not sure that he can motivate the students as much as he would be able to in his own field. Sometimes he struggles to find real life examples of the mathematics he is teaching and to make the connections with other aspects of mathematics, which he knows is important.

Mike's Local Mathematics Centre arranges for him to spend time in the classroom of an 'expert teacher' in a local school with its own sixth form. The 'expert teacher' also hosts an email discussion group, providing a forum in which non-mathematicians can get advice on planning from mathematicians in university mathematics and education departments, and from experienced teachers. Mike is attending a course at his local HEI which is aimed at teaching mathematics to young adults, and in particular he is considering the application of mathematics.

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