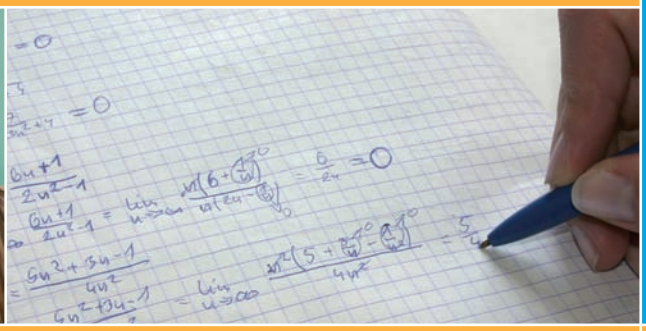
ACME

Advisory Committee on Mathematics Education

Mathematics in Further Education colleges



POLICY REPORT

ACME PR/08

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Foreword

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

Mathematics teaching in the Further Education sector plays a critical role in the delivery of post-16 education, but evidence suggests that this sector remains relatively unknown to policymakers. In view of this, the Advisory Committee on Mathematics Education (ACME) commissioned a study into mathematics teaching in Further Education colleges, with the aim of identifying best practice in the management and provision of mathematics within institutions.

This report asserts that the government, its agencies and colleges should clearly acknowledge the dual importance of mathematics as an academic subject in its own right and as a subject that underpins vocational disciplines, and ensure that future policies implemented within the Further Education sector do not result in a reduction in the provision of mathematics teaching. With the National Centre for Excellence in the Teaching of Mathematics (NCETM) now launched, the report also recommends the establishment of mathematics-based regional centres to ensure both the development of high quality mathematics teaching and professional training for mathematics teachers in the Further Education sector.

ACME welcomes all views on this, its fourth self-initiated report, and is also pleased to receive feedback on any other issues that are of particular concern to the mathematics education community. Whilst we cannot undertake to act on every request or piece of information we receive, we do pledge that everything we do receive will be read, considered fully, and taken into account.

The Advisory Committee on Mathematics Education (ACME) is an independent committee, based at the Royal Society and operating under its auspices, that acts as a single voice for the mathematical community on mathematics education issues, seeking to improve the quality of such education. ACME was established by the Joint Mathematical Council of the UK and the Royal Society, and is supported by the Gatsby Charitable Foundation. Details of ACME's current membership and activities are available at **www.acme-uk.org**

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Executive Summary

This ACME report is about mathematics in Further Education (FE) colleges[1]. The report makes recommendations to FE policymakers and stakeholders to complement the government's three strategies of: increasing the uptake of mathematics in post-16 education to contribute to a strong supply of future scientists, technologists, engineers and mathematicians; improving the mathematical skills of the workforce to contribute to economic competitiveness; and improving the overall quality of teaching and learning in the FE sector.

Mathematics is often seen as an academic, school-based subject. However, the FE sector provides (for a student cohort that has a wider variety of profiles than the schools sector) a breadth of opportunities, within numerous qualifications, to develop mathematical skills and understand mathematical concepts in vocational contexts. These opportunities are not always realised, as mathematics is often not recognised within the FE college sector as a subject that underpins many vocational disciplines. In extreme cases this can lead to mathematics disappearing from syllabuses altogether, a serious concern given the national shortage at all levels of people with the ability to understand and use mathematical ideas and skills.

The report shows that in the best colleges there is a clear identity, strategic vision, leadership and management of mathematics as a subject, and therefore good take-up of the subject by students. However, in other institutions the management of mathematics can be patchy, with often disparate planning of numeracy, 'academic' mathematics, 'vocational' mathematics, and teaching and learning support. It is hoped that college principals and managers will work together, with others, to ensure that the FE college sector is in a position to deliver a mathematics curriculum that will be changing rapidly over the coming years.

Summary of recommendations

For the Department for Education and Skills (DfES) and the Learning and Skills Council (LSC)

- Mathematics should be clearly identified by DfES and LSC as both an academic subject in its own right and as a subject that underpins vocational disciplines. Any future policies should recognise this dual importance and must not result in colleges reducing their provision of mathematics.
- The LSC and the DfES should work together to make the data on mathematics in colleges more accessible and obtain additional data as the need is identified.
- Until new qualifications are available, Free Standing Mathematics Qualifications (FSMQs) should be given an enhanced profile and recognised as contributing to the government's Public Service Agreement targets.
- We recommend the establishment of mathematics-based Centres of Vocational Excellence (CoVEs) to support the development of excellent provision across the whole range of mathematics offered in colleges, both vocational and academic. These would be linked with and supported by the new National Centre for Excellence in the Teaching of Mathematics (NCETM).

For College Principals and Managers

- In addition to working closely with their local feeder schools, Mathematics departments in colleges need to network in clusters so that they can be better informed and support each other. Networks should build on existing good practice within local authority areas, and should be well publicised and accessible to all.

[1] The report does not cover all mathematics taught in the learning and skills sector in its widest sense, partly because ACME's remit is effectively 5-19 mathematics education in England, but also because of the practical advantages of focusing on the FE college sector for this particular project. Many colleges are also responsible for work-based provision, offender education and adult and community learning.

- All students need to be encouraged while on a programme of study, and especially on the completion of a unit, to continue with their mathematical studies for as long as possible.
- Until new qualifications are available, colleges that currently do not use FSMQs should consider whether they would be a better alternative to (or preparation for) retakes in GCSE Mathematics or Key Skills Application of Number.
- Colleges should encourage students who are particularly able in A level Mathematics to aim for the highest qualifications in mathematics; to achieve this goal they should be associated with a local Further Mathematics Centre.
- Every college should have a well defined area dedicated to the teaching of mathematics and resourced with computers, software and other materials.
- All colleges, and especially General Further Education (GFE) colleges where A level Mathematics provision is particularly vulnerable, should do more to promote advanced mathematics by becoming partners in their local Further Mathematics Network.
- We recommend that suitable incentives should be put in place to encourage all relevant staff in the college sector to gain professional qualifications in mathematics.
- All those who are specialist numeracy teachers should gain a Level 4 qualification in teaching numeracy. In addition, we feel that where teachers from another specialism teach a significant amount of Key Skills Application of Number, they should be encouraged to gain at least the Level 3 Numeracy Teaching Qualification.
- Every college should ensure that one person has the responsibility for coordinating all mathematical activity across the college. This person should also be in charge of continuing professional development (CPD) for all teachers of mathematics, to ensure the sharing of good practice, subject knowledge and pedagogy. S/he should also act as a link to regional mathematics centres.

For the Quality Improvement Agency (QIA) and Learning Skills Network (LSN)

- The QIA and LSN should explore and promote, in consultation with the NCETM, models of good collaborative practice for the delivery of Mathematics elements within vocational programmes. These should be used to inform the current delivery of Key Skills Application of Number and the future delivery of functional mathematics.

For the Qualifications and Curriculum Authority (QCA), the Diploma Development Partnerships (DDPs), the Awarding Bodies and others involved in curriculum and qualification design and regulation.

- The role of FSMQ qualifications, in addition to functional mathematics, within the specialised vocational 14–19 diploma framework should be clarified by the Qualifications and Curriculum Authority (QCA). The Diploma Development Partnerships (DDPs) should use the FSMQ model as a basis for the design of mathematics units within specialist diplomas.
- The design of functional mathematics should learn from the successful features of FSMQs, in particular ensuring a balance between process skills and mathematical content, and supporting integration into mainstream vocational or academic courses.
- In trials of any new Mathematics GCE qualifications, one option should include a component in the style of AS Use of Mathematics and there should also be consideration of a follow up A2 component to make this into a full A Level.

- Specialist diplomas that require Level 3 Mathematics units should include a component based on the style of the AS Use of Mathematics.
- The design of mathematics textbooks and resources should learn from the DfES's Standards Unit approach exemplified in *Improving Learning in Mathematics*.

For the Training and Development Agency for Schools (TDA) and the Life Long Learning Sector Skills Council (LLUK)

- General FE colleges should be recognised in addition to Sixth Form Colleges as suitable bases for a probationary period in mathematics teaching leading to Qualified Teacher Status.
- We recommend the establishment of specialist PGCE (FE) courses in mathematics. In each region of England one Centre for Excellence in Teacher Training (CETT) would be chosen to have the lead responsibility for the training of mathematics teachers in FE colleges. These centres should be linked with the regional centres of the NCETM and it would be appropriate, where possible, to link these with the more general Centre of Vocational Excellence (CoVE) status in mathematics.
- We recommend that the new standards for teachers in the lifelong learning sector should include a requirement that qualified teacher status cannot be achieved unless a level 2 qualification in numeracy is possessed by the FE teacher. The new standards should also require a teacher to demonstrate how they can embed functional mathematics in their specialist area.

For the National Centre for Excellence in the Teaching of Mathematics (NCETM)

- There should be continued investment, through the NCETM, in the *Framework for Mathematics* originally produced by DfES's Standards Unit, now part of the Quality Improvement Strategy for the learning and skills sector. A major role for the NCETM is to support the embedding of this approach.
- The NCETM should encourage the LSC and the Association of Colleges (AoC) to bring to the attention of principals and college managers the planned activities of the NCETM and work actively with the NCETM to ensure that colleges are fully represented in these activities.
- The NCETM should play a lead role in raising awareness of what constitutes sustained CPD. It should recommend to LLUK the proportion of the new CPD entitlement for teachers of mathematics within the FE sector that should be subject specific. It should also clearly identify and kite mark opportunities for sustained CPD.

For the Office for Standards in Education (Ofsted)

- The inspection of mathematics in colleges should report under the heading of mathematics, and should include under this heading the full range of mathematics on offer right across the college. The inspection reports of mathematics should include detailed analyses and grades for each of the different programme areas inspected. A database of grades awarded to colleges should be established and maintained to facilitate the identification and dissemination of good practice.

For careers services

- Careers services should do more to provide college students with information explaining the mathematical needs of higher education and employment, and should ensure that students are aware of the benefits of possessing qualifications in mathematics for a range of jobs and careers.

1 Background to the study

Mathematics in the FE sector

1.1 The UK is already experiencing a major shortage of young people with transferable mathematical skills to fulfil demands in the workplace, to provide sufficient students qualified for study of numerate disciplines in higher education, and to significantly increase the numbers of competent teachers of mathematics. This shortage is putting at risk the strength of the nation's research and development base and ultimately its economic competitiveness. The importance of mathematics to the economy and the urgent need to develop mathematical skills and confidence at all levels were spelled out in the Smith Report[2]. The colleges in the FE Sector have an important place to play in this endeavour, especially with the current government emphasis on ensuring a structure of provision that will help deliver new 14-19 mathematics curricula, whether they are academically or vocationally oriented.

1.2 The college sector that forms the focus of this project consists of some 409 colleges in England[3]. There are four major types of college in the sector:

- **General FE colleges (GFEs):** colleges that offer a wide range of vocational programmes, together with some general provision. Their programme is available for all ages post-16 (with an increasing role post-14). Some general FE colleges have a substantial academic programme; others focus almost exclusively on their vocational programme.
- **Tertiary colleges (TCs):** these colleges are planned to offer the full range of provision – vocational and academic, full-time and part-time, for most post 16 learners in their area.
- **Sixth form colleges (SFCs):** these offer a full-time programme for mainly 16-19 learners. In many cases local feeder schools are designed to be 11-16 in their age range, but they may also recruit from 11-18 schools.
- **Specialist and specialist designated colleges (SCs):** Specialist colleges are colleges that focus on one specific area. Most serve the land-based industries, although some are art and design colleges. Specialist designated colleges mainly serve adult learners.

Available information at the time of this study summarises the 409 English colleges as follows: 267 GFE (including tertiary), 104 SFC, 38 specialist and specialist designated; it is estimated that the number of TCs is about 30.

The focus of this project was GFEs, TCs and SFCs.

1.3 Up to 1993 colleges were part of local education authorities, and their provision was usually planned in the context of their LEA's policies for progression at 16. In 1993 colleges were incorporated as independent charitable organisations. They are funded by the Learning and Skills Council (LSC). The college sector has recently been the focus of the Foster Report[4].

[2] *Making Mathematics Count: The Report of Professor Adrian Smith's Inquiry into Post 14 Mathematics Education,* The Stationery Office, February 2004.
[3] *Further Education Workforce data for England – an analysis of SIR data for 2003/4,* Lifelong Learning UK, 2005. (The total number of colleges is falling as colleges amalgamate.)
[4] *Realising the Potential: A review of the future role of further education colleges,* DfES publications, 2005.

1.4 The contexts within which colleges work vary significantly. In many areas, especially in cities, there is a competitive ethos in which a number of post-16 providers – schools, SFC, GFE – compete vigorously for students with little co-operation relating to the progression of students and the sharing of professional expertise. In other areas progression of students is managed through a tertiary system where all 16-year-olds progress to one college which offers the full range of choice of learning pathways.

1.5 Between these two extremes there are many variations. For example in some cities secondary schools are feeder schools to a SFC, with the remainder of the provision conforming to the competitive model. In some areas the post-16 system is a binary one where students either progress to an academically based SFC or a vocationally based FE college. Most SFCs have about 1000 or more students so that in some urban areas there is just one such college, whereas in larger urban areas there may be several.

1.6 Across all subjects, colleges offer the majority of A Level provision and most 16-19 vocational qualifications, although the proportion of A level entries does vary significantly across the country. In particular, there is a wide variation across the areas covered by this study, with 100% of A level entries in the non-independent sector in Richmond from the FE sector, and over 90% in Southampton, Hampshire and Hull, to less than 20% in Peterborough, North Yorkshire, Derbyshire, Kent and Gateshead.

About the project

1.7 Forty-two colleges across England were contacted; of these, 28 supplied evidence to the study (see p. 37 for full list of colleges).

1.8 The aim of the study was to collect evidence from a range of colleges to examine:

- strengths and weaknesses of the organisational structures for mathematics and numeracy in a range of institutions which could all be regarded as effective in management and provision;
- how these different institutions are catering effectively for the needs of people in their communities and in local employment, including any effects of external pressures on the quantity, range and quality of mathematics teaching in colleges;
- the capacity of colleges to deal with developments in the post-14 qualifications framework, and in particular how the key role of 'functional mathematics' would be incorporated;
- the capacity of colleges to deal with the CPD needs of all staff engaged in teaching mathematics, regardless of which team or department the staff belong to.

1.9 In this report the word 'mathematics' will be used as the umbrella word covering all aspects of mathematics, including GCSE and GCE Mathematics and related qualifications, vocational mathematics, workplace mathematics, numeracy learning support key skills, Application of Number (AoN) and Adult Basic Skills Numeracy (ABSN).

1.10 Evidence has been collected from several sources. These include contributions from and meetings with members of Ofsted, the DFES Standards Unit, QCA, the Chief Adviser on Mathematics at the DFES, the Principals' Mathematics Group of the Association of Colleges, and staff from colleges. This last category included a range of practitioners with responsibility for some or all aspects of mathematics, AoN or ABSN, and also members of senior management. We have also drawn on evidence cited in published reports, including the Smith Report, several ACME reports, recent Ofsted reports on individual colleges, and the 1999 report of the Further Education Funding Council (FEFC) inspection of mathematics in colleges. The professional subject associations represented on the Joint Mathematical Council of the UK (the JMC) also provided evidence in response to a questionnaire.

1.11 A series of five regional meetings around the country was arranged with staff invited from several selected colleges in each region. The colleges were chosen to include a mix GFEs, SFCs and TCs, where this was appropriate. In each region, one college was also chosen for an in-depth visit to see how mathematics in its widest sense was organised and delivered.

1.12 The report highlights some evidence of good practice and apparent obstacles to it, and makes recommendations for action.

1.13 The report presents observations on a range of issues. These relate to: college organisation; teaching staff; CPD; attitudes to mathematics; course provision and progression; effects of funding mechanisms on provision; student numbers; use of technology and other resources; local networks; and some perceived differences between GFEs, SFCs and TCs.

2 Mathematics in colleges today

The college context

2.1 Mathematics is seen by society and by employers as a critical gatekeeper subject in terms of qualifications for life and employment. There is no other subject, apart from English, that is given as much curriculum time in English schools; and there is certainly no other subject that causes as much angst to students (and sometimes their teachers). Those that possess qualifications in mathematics at Level 3 or above are sought by employers and have enhanced average earning power over those, otherwise equally qualified, who do not possess these qualifications[5]. At the other end of the scale, those with no qualifications at all in mathematics are the ones with the highest rates of unemployment and the very lowest earnings.

2.2 Many students aspire to obtain qualifications in mathematics. The further education sector provides students with the opportunity of gaining a recognised qualification in mathematics. It also provides for upward progression of qualifications in mathematics, and it provides opportunities for consolidation and improvement.

2.3 Mathematics is taught in several ways in colleges:

- As a subject within a programme of several subjects, leading to a mathematics qualification at levels 1, 2 or 3 of the National Qualifications Framework. These qualifications include:
  - Mathematics: Foundation, Intermediate and Higher
  - GCSE Statistics
  - Free Standing Mathematics Qualifications (FSMQs) at Levels 1–3
  - AS Use of Mathematics
  - GCE AS Mathematics and A Level Mathematics
  - GCE AS Further Mathematics and A Level Further Mathematics
  - Advanced Extension Award (AEA) in Mathematics[6]
- As a 'servicing' subject as part of a programme of learning leading to a vocational qualification[7].
- In the form of AoN, as a major component of Key Skills at levels 1–3, this is a requirement of many college programmes.
- In the form of an adult numeracy qualification (at Entry levels 1, 2, and 3, and Levels 1 and 2), which is a major component of the Skills for Life initiative, although some students are following only a numeracy course.

Some classes are entered for more than one of these qualifications.

These qualifications are currently being revised so that they are better integrated within a diploma framework. In 2009, Functional Mathematics qualifications, will start to replace Key Skills AoN and ABSN, which are already assessed using the same written tests. Functional Mathematics at the

[5] *The Returns to Education - Centre for Longitudinal Studies Briefing,* Institute of Education, University of London, June 2006.
[6] First examined in 2002, AEAs superseded Special Papers to help differentiate between the most able students.
[7] Vocational qualifications tend to be divided into two types: Vocational Related Qualifications (VRQs) and National Vocational Qualifications (NVQs). The current review of vocational qualifications coupled with the introduction of the credit-based Framework for Achievement may entail that the distinction between VRQs and NVQs will not continue for much longer.

appropriate level will be required as part of a new suite of Specialist Diplomas planned in 14 vocational areas, and at Level 2 will become a requirement for GCSE grade C. Between 2006 and 2009 there will be trialling of new forms of provision at GCSE and GCE to be implemented from 2010 onwards. It is not yet clear whether FSMQs will continue. These changes have considerable implications for provision in FE colleges and for professional development of staff to implement them.

2.4 In FE much of mathematics is hidden; this is because it is delivered within vocational areas, or as numeracy within a broader Skills for Life or Key Skills AoN course. Even within the vocational areas mathematics may be taught within a unit that has some acknowledgement of mathematical content in the title, or some mathematical processes may be taught as a necessary aspect of a purely vocational unit. This is a problem that has been highlighted in the National Report for 1998–1999[8] from the Inspectorate of the Further Education Funding Council.

2.5 Thus although the FE sector provides a breadth of opportunities to develop mathematical skills and concepts in vocational and work-based contexts, these opportunities are not always recognised in FE colleges. Where the potential for the development of students' mathematical capabilities in such vocational contexts is missed, this is a serious concern given the national shortage at all levels of people with the ability to understand and use mathematical ideas and skills.

2.6 There is also one possible unintended effect of the Foster report[9] that concerns us. The report suggests that GFEs adopt an economic rationale for their mission, with SFCs being more explicitly academic. There is a danger that some colleges may reduce their mathematics departments because they do not perceive the economic value of mathematics. We feel this would be a dangerous and retrograde step.

2.7 *Making Mathematics Count*[10] described mathematics as:

'…a major intellectual discipline in its own right, as well as providing the underpinning language for the rest of science and engineering and, increasingly, for other disciplines in the social and medical sciences. It underpins major sectors of modern business and industry, in particular, financial services and ICT [Information and Communications Technology]. It also provides the individual citizen with empowering skills for the conduct of private and social life and with key skills required at virtually all levels of employment.'

Staff from some of the colleges interviewed indicated that mathematics was not perceived as important as other areas, as it was not associated directly with a vocation or a large employment sector. The recent LSC policy for priority-led funding may have exacerbated this situation. Regional and local LSCs have undertaken an environmental analysis and set priorities for provision in their area. The priorities set appear to relate mainly to vocational sectors and basic skills. In some instances they miss the importance of underpinning disciplines; for example, in the London Region, engineering was set as a high priority, whereas mathematics was set as a low priority. This missed the value of qualifications such as GCE A level Mathematics and, indeed, Further Mathematics to those wishing to progress to engineering degrees, for example. Again there is a danger that colleges reduce their mathematical provision based on an underdeveloped policy.

Recommendation 1

Mathematics should be clearly identified by DfES and LSC as both an academic subject in its own right and as a subject that underpins vocational disciplines. Any future policies should recognise this dual importance and must not result in colleges reducing their mathematics provision.

[8] *Mathematics in Further Education,* FEFC, 1999.
[9] *Op. Cit.*
[10] *Op. Cit.*

2.8 Mathematics provision in further education is classified under two different headings by the Learning and Skills Council: Mathematics and Statistics (Sector Subject Area (SSA) 2.1), and Preparation for Life and Work (Sector Subject Area 14). The data directly related to mathematics, statistics and numeracy for 2004/5 under these headings are given in Table 2.1, with that under SSA2 further split into sub-categories.

2.9 Table 2.1 demonstrates that of the £165M which supported mathematics provision in the FE sector in 2004/5, 70% of the money was for 16- to18-year-olds and 30% for adults; while 56% was for preparation for life and work, 36% for GCSE/GCE qualifications, and the remaining 8% for other qualifications.

Table 2.1: Students enrolled and funding provision from LSC for mathematics in FE in 2004/5 by age (16-18 and 19+) and by qualification. (It was not possible to separate out the mathematics component of the generic mathematics/science area.) The levels refer to levels of the National Qualifications Framework[11].

Qualification	Ages 16-18		Ages 19+		Total	
	Enrolled	£(000s)	Enrolled	£(000s)	Enrolled	£(000s)
Entry Level	374	*193*	86	*20*	460	*212*
Level 1	3,305	*1,422*	379	*128*	3,684	*1,550*
GCSE	43,414	*20,871*	22,766	*8,139*	66,180	*29,010*
Level 2	926	*377*	46	*24*	972	*401*
FSMQ	2,701	*1,031*	308	*121*	3,009	*1,152*
GCE A/AS	39,531	*28,598*	3,477	*1,887*	43,008	*30,486*
Level 3	266	*73*	92	*55*	358	*128*
Other	1	*0*	18	*7*	19	*7*
Generic M/Sci	4,311	*2,005*	28,764	*7,244*	33,075	*9,249*
SSA 2 total	94,829	*54,570*	55,936	*17,624*	150,765	*72,194*
SSA 14 total	182,356	*60,751*	89,666	*32,794*	272,022	*93,544*
Total	277,185	*115,321*	145,602	*50,418*	422,787	*165,738*

2.10 The percentage of entries for GCE A-level Mathematics that come from FE is smaller than for many other subjects. The inter-awarding body statistics[12] for Summer 2005 show that entries from FE account for 24.5% of a total entry of 57,440. The 24.5% from FE is made up of 15.8% from SFCs, 4.9% from GFEs and 3.8% from TCs (the median proportion for A-level entries in FE across all subjects and local authorities is 55%. This was calculated from the data on A level results published in 2005 by the DfES.)

2.11 It has taken a considerable amount of time to compile the data in these paragraphs.

Recommendation 2

The LSC and the DfES should work together to make the data on mathematics in FE more accessible and obtain additional data as the need is identified.

2.12 The relative importance of different strands of provision varies with colleges. In GFEs mathematics may appear in all of the four areas listed at the beginning of this chapter, although many such colleges are moving towards a more explicitly "vocational" mission and losing their GCE A level and GCSE provision. In a TC all four strands will be in evidence. In SFCs the "servicing" role is likely to be absent, and the element of numeracy within a Skills for Life programme may be minimal or non-existent. Even within a type of college, the nature of the local market for learning is very varied, as noted in Chapter 1, and has a major effect on the policies that colleges adopt towards the recruitment of students, which in turn significantly influences the nature of their mathematics programme.

2.13 The provision of mathematics in a college is also affected by the policy that the college has towards enrolling students. Some colleges operate an open enrolment system, in which

[11] Data provided by the National Learning and Skills Council.
[12] Inter-awarding body statistics Summer 2005, Joint Council For Qualifications, 2005.

students are enrolled on to the next stage provided they have achieved the minimum necessary to progress. Others have requirements that exclude those who they feel are unlikely to succeed. In mathematics this means that many mathematics departments will enrol students onto an A level course only with a grade B at GCSE. An open enrolment policy would enrol all those with a grade C.

2.14 Ofsted has recently published a thematic review evaluating mathematics provision for 14- to 19-year olds[13]. This study focuses on the main factors leading to high achievement, motivation and participation in 14–19 mathematics and numeracy. However very little is known about the mathematics provision that lies outside of academic qualifications, for example the mathematics within a BTEC National Diploma in Engineering. Although inspected, these mathematics elements are not usually explicitly mentioned in inspection reports, and most other sources of data are not immediately helpful. It is therefore difficult to ascertain how prepared the sector is for future developments in functional mathematics and any mathematics that forms part of future specialist diplomas.

2.15 This project sought to identify colleges which could be described as exemplars of good mathematics provision. It was expected to discover them through Ofsted grades. One difficulty with this was that often mathematics is subsumed within an overall grade for mathematics and science. Occasionally however the quality of mathematics provision is separately identified within the overall grade. A more serious problem is that there is no Ofsted database of grades to which it is possible to refer. The inspection report of each college must be accessed and then investigated to find whether there is any mathematics grade.

2.16 In addition, the most recent inspection reports may not contain any curriculum grades but are restricted to grades about the college in general. By adopting these two policies Ofsted is frustrating a potentially valuable use of their inspection reports which is to enable researchers, college staff and others to identify where good practice exists.

Recommendation 3

The inspection of mathematics in colleges should report under the heading of mathematics, and should include under this heading the full range of mathematics on offer right across the college. The inspection reports of mathematics should include detailed analyses and grades for each of the different programme areas inspected. A database of grades awarded to colleges should be established and maintained to facilitate the identification and dissemination of good practice.

Networks of support

'FE colleges should work together (and with other providers) to improve learning pathways and choice (including for the 14-19 phase) and to realise the opportunities for economies of scale, development and innovation.' (The Foster Report, p.82)

2.17 The study of colleges revealed that several of them were involved in some form or other of local networking. Nevertheless, there were other colleges that were not part of any local network and had no links with local schools or LEAs. Sometimes the respondents were not sure whether or not such links existed and there was no apparent incentive for such links.

2.18 Evidence given included some links with feeder schools, some local involvement in meetings with heads of mathematics, and relatively little interaction with LEAs except for SFCs and TCs. A few colleges had links with universities, and several colleges stated explicitly that they had no such

[13] *Evaluating Mathematics provision for 14-19 year olds,* Ofsted, May 2006

links, nor links with any schools.
Most colleges sent staff to meetings organised by awarding bodies. Few colleges had links with other colleges. One college reported some involvement in mathematics with the Open College Network, and another reported working with support groups for the National Institute for Adult Continuing Education (NIACE) and for teachers of adults with disabilities. Several colleges were linked into a local Further Mathematics Network and two mentioned regional mathematics networks of the LSC.

2.19 It is interesting to note that colleges that have been graded by Ofsted as outstanding or good in mathematics tend to have a variety of important links to other institutions and networks.

> 'We attend Borough Heads of Mathematics meetings and subject leader training days. The department has strong links with local schools and the LEA, and hosts a Maths Challenge for year 7 pupils in the schools. We also go into local schools to talk to year 11 students about post-16 opportunities in mathematics.
>
> 'Students on the Mathematics Enhancement Course at the local university use the department for lesson observations.
>
> 'The college is part of the South West London Further Mathematics network, and the interviews for the Centre Manager were held here using college students as part of the process.
>
> 'We are members of the Mathematics network group organised by the LSC. We will be attending the conference organised by the London Mathematics Centre and the Lighthill Institute for Mathematical Sciences on Mathematics in the School–University Interface – New Approaches.'

2.20 In recent years colleges and local authorities have established strategy groups focusing on provision for 14- to 19-year olds in their area. However, these groups are generally formed of senior managers and there is relatively little opportunity for subject practitioners to work together. In some regions, Heads of Mathematics from schools and colleges do meet regularly, but this seems to be uncommon. It is much more common to find mathematics departments in colleges acting in relative isolation. The new National Centre for Excellence in the Teaching of Mathematics (NCETM) will have a key role in building the capacity of local and regional mathematics networks ensuring that colleges, schools and local authorities work together to improve provision and share good practice.

Recommendation 4

In addition to working closely with their local feeder schools, mathematics departments in colleges need to network together in clusters so that they can be better informed and support each other. Networks should build on existing good practice within local authority areas; they should be well publicised and accessible to all.

2.21 This section has reported on some of the diversity of mathematics provision among colleges in the FE sector. As a final point we note that the members of staff from one of the colleges in the study volunteered that "teaching genuine mathematics in FE is very rewarding because of its diversity."

Progression and transition

2.22 Students' progression in mathematics is a key issue. Colleges should provide a majority of all students with genuine progression in mathematics, and the opportunity to fulfil their mathematics potential, where necessary allowing this to develop over a longer period than normal.

2.23 There are three aspects to this progression. Two of these are transition issues. The third is the suitability of the provision made available by the college for students: the mathematics that is on offer and how progress is monitored and ensured. Of course, these aspects are all interlinked, but it helps to decouple them for the purpose of analysis.

2.24 The first of the two transition issues is whether the college has provided a suitable programme for every student to build upon what was achieved (or partly achieved) before leaving school, or before entering the further education sector. A key factor is how the college assesses its incoming students for their mathematical competencies and assigns them to courses. Experience suggests that some students end up on a course where the work is inappropriate: either too easy, too hard or not relevant to their interests. This can lead to negative attitudes and high rates of withdrawal or failure. Some colleges undertake diagnostic testing during student induction in order to assign them to appropriate courses.

2.25 The second transition issue is about students' abilities to cope with the mathematical needs of employment (which frequently also require competent use of ICT packages), or with the mathematics demanded on a range of courses in higher education, including disciplines such as the sciences, engineering, geography, economics, business studies, psychology and other social sciences. Students will want to know whether the college has provided them with sufficient education in the mathematical prerequisites for the degree-level courses they choose. Admissions tutors in higher education will want to know whether the college has developed the necessary mathematical skills and knowledge to enable students to cope on their courses. Students should be aware of how their employability prospects and earning power are likely to grow if they possess qualifications in mathematics at Level 3 or above.

Recommendation 5

Careers services should do more to provide students with information explaining the mathematical needs of higher education and employment, and should ensure that students are aware of the benefits of possessing qualifications in mathematics for a range of jobs and careers.

2.26 The government has stressed the urgent national need for more students to obtain qualifications in mathematics at Level 2 and above. Unless this is achieved the much publicised skills shortage will become even more exacerbated.

Recommendation 6

All students need to be encouraged while on a programme of study, and especially on the completion of a unit, to continue with their mathematical studies for as long as possible.

GCSE: retakes and alternatives

2.27 There is currently much confusion about what 'Level 2 Mathematics' means because the curriculum content of GCSE Mathematics Grades C – A* and the knowledge and understanding to perform at this level are the benchmark for Level 2 mathematics, whereas AoN or key skills at Level 2, or a single FSMQ at Level 2, are not equivalent qualifications. The new arrangements, to be implemented from 2009 onwards, should help to resolve this problem.

2.28 Forty-seven per cent of English students failed to achieve a pass in GCSE Mathematics at grade C or above in 2005[14]. Many colleges wrestle with the problem of what to provide for those who have not achieved a grade C at GCSE. Currently, many students aged 16–19 enrol on re-sit GCSE programmes, with GCSE Mathematics a popular choice. However, retention rates for GCSE Mathematics in the colleges surveyed in the study seemed to vary on average between 50% and 85%, and success rates rarely reached 30%. Some teachers in the study suggested that it is unlikely for a student with a grade below a D to be able to achieve a grade C after one year of further study, and to enter these students for GCSE reinforces previous failure. For this reason, some of the colleges interviewed were asking for a grade D in GCSE Mathematics for entry to courses, to allow a student to re-sit in one year. As might be expected, in these institutions pass rates had increased. For this or other reasons, there is some experience from the colleges in this study that the number of candidates for re-sits may be decreasing.

2.29 Funding constraints dictate the number of guided learning hours, which then determine the number of teaching hours that have to be paid for. The current funding mechanism is inflexible. For example, there is no allowance for students who may need to take longer than a year to reach GCSE standard to do so unless they are taught, for example, for half the time over twice as long a period.

2.30 Some colleges have been creative in the way that they deliver their curriculum, providing more time by offering Key Skills or an FSMQ alongside a GCSE qualification. In some instances colleges offer a two year programme to students with lower GCSE grades. The first year of this programme comprises either AoN, Numeracy or an FSMQ, or a combination of these. The students then progress to resit GCSE, if required, in the second year. The use of FSMQs helped to boost students' success rates, and to improve the quality of their learning experience. Colleges using the FSMQ qualifications felt that their students were provided with their first taste of mathematical success. In addition, some of the colleges used FSMQs to support vocational qualifications, for example, offering an Algebra, Functions and Graphs FSMQ to BTEC National Diploma Engineering students to boost their mathematical skills. However, staff were unclear about what the definitive funding rules were for offering these options. In several cases they had decided not to offer better alternatives to students citing funding as the block to their development.

Several colleges manage to improve the learning of GCSE mathematics with imaginative use of level 1 or 2 FSMQs or of AoN to boost the weekly contact time available to students.

In a similar way, Level 3 FSMQs are used in some colleges to support teaching for AS Mathematics, or to promote AS Use of Mathematics as a better alternative to AS Mathematics. These colleges are constructively dealing with student diversity.

2.31 FSMQs are still not universally known, and some heads of mathematics had not heard of them. The demand for GCSE among stakeholders is also very strong. It is very difficult for colleges to persuade students and parents that these courses are a more realistic alternative. Some of these problems may be resolved in the future with students following a Functional Mathematics Level 2 qualification in one year before going on to attempt to achieve GCSE at grade C.

Recommendation 7

Until new qualifications are available, colleges that currently do not use FSMQs should consider whether they would be a better alternative to (or preparation for) retakes in GCSE Mathematics or Key Skills Application of Number.

[14] Source: Joint Council for Qualifications, National Provisional GCSE (Full Course) Results – June 2005 (England Only), Cumulative Percentages of Subject Results by Grade and by Gender. See http://www.jcq.org.uk

Key Skills: Application of Number

2.32 Very large numbers of students on vocational courses are currently offered Key Skills AoN. However, because these qualifications are no longer a requirement for success in the main vocational qualifications, the key skills tests alone – now certificated as Adult Numeracy Qualifications – are often preferred to the full key skills AoN assessment model which involves both a test and a portfolio. Teachers involved in the study criticised some of the test items as difficult for learners to understand. The requirements for the portfolio were also exacting and moderation was reported to be time-consuming. Pass rates on key skills qualifications, whether the tests alone or the tests and portfolio together, were often poor. One college in the study had approximately 2000 students doing AoN, but achieved a success rate of around 7%. This clearly is a matter of great concern, especially as it was reported that few students have a positive learning experience from AoN and many opt out. Most teachers who gave evidence to this study had little to say in favour of retaining these qualifications.

2.33 Nevertheless, present funding mechanisms tend to drive the promotion of key skills qualifications at the expense of other qualifications. For example, qualifications in AoN contribute to Public Service Agreement (PSA) targets and qualifications such as FSMQs do not. Yet there is some doubt among the mathematics community that the Key Skills AoN qualifications develop the transferable mathematical skills and understanding that are demanded of today's workforce. They are also difficult to integrate into the vocational courses because they have been constructed independently; ideally the mathematics ought to contribute to the understanding of, and facility with, the vocational course. Indeed this was a motivation behind the development of FSMQs.

2.34 The Smith Report recommended FSMQs as an alternative:

'It is perhaps sensible to consider Free Standing Mathematics Qualifications (FSMQs). Some of these are assessed through the use of a portfolio and external examination, and differ from AoN in that their specifications are designed so that students can demonstrate progression over time within their portfolio work. There is also a degree of flexibility in the content required which makes it easier to integrate material within vocational areas. Some use examination pre-release materials, allowing students to gain an understanding of the context before the examination. (A criticism of the AoN tests is the degree of literacy required to approach them successfully.) Overall, particularly at levels 1 and 2, the FSMQs appear to be better designed to match the skills to be assessed.'[15]

Recommendation 8

Until new qualifications are available, Free Standing Mathematics Qualifications (FSMQs) should be given an enhanced profile and recognised as contributing to the government's Public Service Agreement targets.

2.35 The QCA standards for functional mathematics are currently being considered and different forms of assessment will be trialled from September 2006 onwards. It is still not clear whether FSMQs will eventually be replaced or retained in their current or in a new form: trials of different structures are also taking place from September 2006. The positive characteristics that have contributed to the value of FSMQs for teaching and learning should be retained in the new developments.

Recommendation 9

The role of FSMQ qualifications, in addition to functional mathematics, within the specialised vocational 14–19 diploma framework should be clarified by QCA. Diploma Development Partnerships (DDPs) should use the FSMQ model as a basis for the design of mathematics units within specialist diplomas.

[15] *Making Mathematics Count: The Report of Professor Adrian Smith's Inquiry into Post 14 Mathematics Education*, The Stationery Office, February 2004.

Recommendation 10

The design of functional mathematics should learn from the successful features of FSMQs, in particular ensuring a balance between process skills and mathematical content, and supporting integration into mainstream vocational or academic courses.

GCE AS and A level Mathematics

2.36 An important issue about progression beyond GCSE Mathematics has been where to place students who start with a grade C in GCSE Mathematics, in particular if awarded on the Intermediate tier of entry. This will continue with a two-tier system to be introduced for first teaching in 2006, although it is hoped that more students will be entered for the Higher tier so the size of the problem may be reduced. However, those students who have achieved a grade C on the new Foundation tier may be even less equipped than on the current Intermediate tier as the new Foundation covers a wider range of levels below grade C. It is generally agreed that many students who have obtained grade C in GCSE Mathematics (even those who have done the Higher Tier) struggle with the demands of AS Mathematics. A few colleges (commonly SFCs) use the Level 2 FSMQ *Foundations for Advanced Mathematics* to bridge the gap from Intermediate GCSE Mathematics to the standard required to confidently start AS Mathematics. A small but increasing number of colleges are offering level 3 FSMQs, either to boost the mathematics skills of students doing subjects such as AS Physics or AS geography or BTEC National Diplomas in Engineering, or to enable students to obtain the AS Use of Mathematics qualification. Some colleges demand that AS physics students do AS Mathematics to support their physics.

At one sixth form college, the Advanced FSMQ *Using and Applying Statistics* was available to geography students undertaking their geography coursework with the help of the head of mathematics. The students decided whether to sit the examination in the summer after they had completed their coursework. Some of these students then progressed to completing AS Use of Mathematics at the end of their second year.

In an FE college, students studying a BTEC National Diploma in Operations and Maintenance were able to study for a level 3 FSMQ in their first year. Some of these students also progressed to the AS Use of Mathematics in their second year.

2.37 AS Use of Mathematics, a course that focuses on the use of mathematics in modelling realistic situations, was well thought of by those that used it, and numbers of candidates have increased steadily since the qualification was first introduced. It was considered a good AS Level qualification for the less academic, more practical A level student. Moreover, teachers said that teaching this course made them better teachers because they are forced to use ICT in its delivery and they, and the students, have to analyse real data from rich contextual settings. The pass rates are good, although Grade A seems quite hard to achieve. Several colleges in this survey had 50 to 100 candidates for AS Use of Mathematics, with pass rates between 75% and 100%. The most common criticism of AS Use of Mathematics is that there is no A2 continuation to a full A level. Students who had initially opted for an AS level only wanted to take more mathematics because they found they enjoyed it and there was no clear progression route for them.

Recommendation 11

In trials of any new Mathematics GCE qualifications, one option should include a component in the style of AS Use of Mathematics and there should be consideration of a follow up A2 component to make this into a full A Level.

Recommendation 12

Specialist diplomas that require level 3 mathematics units should also include a component based on the style of the AS Use of Mathematics.

2.38 The sample of colleges in the study revealed a marked difference between SFCs/TCs and the more general FE colleges for A level entries. In the former, many students were studying A level Mathematics, sometimes over a hundred, with many also entering for AS or A level Further Mathematics. Few GFEs offer GCE Further Mathematics, and in some of the colleges there are no or very few students doing A level Mathematics. Where colleges cannot themselves offer Further Mathematics it may be possible for their students to attend local Further Mathematics Centres.

2.39 The Advanced Extension Award (AEA) was offered on a more ad hoc basis to exceptional students, usually in SFCs or TCs.

Recommendation 13

Colleges should encourage students who are particularly able in A level Mathematics to aim for the highest qualifications in mathematics; to achieve this goal they should be associated with a local Further Mathematics Centre.

2.40 Because of the national shortage of mathematically qualified people, there is good reason for FE to provide students with a strong grounding in academic mathematics, including not only GCE A-Level Mathematics and Further Mathematics but also the AEA in Mathematics.

The organisation of mathematics provision in colleges

2.41 The organisation of mathematics in colleges is a more complex matter generally than in schools. In schools the mathematics department is a major department with responsibility for all, or nearly all, of the mathematics that takes place in the school. In many colleges this is not the case, although the picture varies depending on the type of college, and the specific markets that they serve.

2.42 Many SFCs have a mathematics department responsible for mainstream mathematics qualifications and possibly, but not always, responsible for Key Skills and other qualifications offered. The relative status of mathematics in these colleges is closer to that in schools.

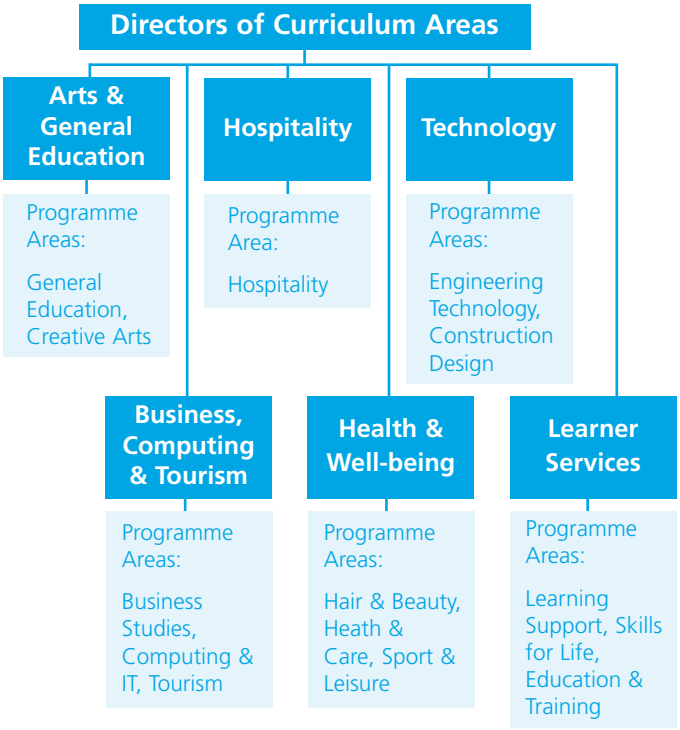
2.43 Some, though few, GFEs follow a similar structure; it is more usual for mathematics, key skills, and adult numeracy to be the responsibility of two or three separate departments (not necessarily managed by a mathematics specialist), with learning support managed elsewhere, and vocational mathematics provided by the individual vocational departments. In some cases, those teaching mathematics and numeracy across such organisations do not collaborate in any way. There are some colleges with no designated mathematics department, even though there may be mathematics teaching taking place.

2.44 Even where an FE college has an established mathematics department, with a mathematics curriculum manager, this person may not have a role in co-ordinating mathematics across the organisation, and management may not recognise the need for such co-ordination. While some colleges have a

cross-college mathematics committee, this is not always chaired by a mathematics specialist.

2.45 In some colleges the locus of responsibility for mathematics is unclear. In this circumstance it is easy for lack of appropriate teacher expertise in mathematics not to be recognised by the parent department for a particular course.

2.46 The faculty structure of most GFEs follows the pattern of vocational provision offered by the college. An example of the organisational structure of a typical large GFE is shown in the diagram below.



2.47 As can be seen in this example, 'mathematics' does not appear in the designation of any of the Programme Areas listed. It is likely that the largest single group of mathematics teachers will be found within the General Education Programme Area, where they will be teaching A levels and GCSE alongside colleagues teaching the usual range of academic subjects.

2.48 In addition there will be an important element of mathematics taught within the Skills for Life and Learning Support areas, teaching numeracy alongside their colleagues teaching literacy. It is often the case that individual teachers will be expected to teach both literacy and numeracy.

2.49 In the various vocational Programme Areas the amount of mathematics required will vary. All will be offering their students a programme of Key Skills which will include AoN to level 1 or 2 and occasionally level 3. In addition some of the courses followed will have a mathematics component. Such courses may be found in Business Studies, Engineering, Construction, Health and Social Care. In several vocational areas the mathematics required is now entirely delivered through AoN. This may be at level 1, 2 or 3 depending on the demands of the vocational area and of the course. The appropriate level for each Key Skill (including AoN) is determined by the relevant Sector Skills Council or other Standard Setting Body for the vocational area.

2.50 The organisation of the delivery of AoN varies a great deal. In some cases the mathematics or the Learning Support team will provide a service to all other Programme Areas. In other cases the Programme Area's own staff will deliver the key skills. In a third group of cases the mathematics specialists advise and support and sometimes team-teach with vocational specialists.

2.51 Some GFEs have concentrated exclusively on vocational courses and therefore do not have a relatively large group of mathematics staff. In some cases mathematics teachers have joined with basic skills and key skills staff to develop a coordinated approach to the delivery of numeracy whether in the context of Skills for Life or in the context of AoN.

2.52 We found examples of colleges where staff in vocational areas like Health and Social Care and Hairdressing had approached the mathematics department to seek their help in ensuring that their students were adequately prepared for AoN.

> In one college the Hairdressing department approached the Application of Number team and requested that they team-teach with the Hairdressing staff. The staff wanted this because they did not want their students to be as lacking in key skills as they were – and wanted to improve their own skills alongside their students.

2.53 However, in another college co-operation was less easy:

> 'The vocational departments are supposed to use our key skills team. This does not happen in all Programme Areas, for example the Head of the Technology Faculty has been unable to persuade the Construction Craft department to use our team for Application of Number.'

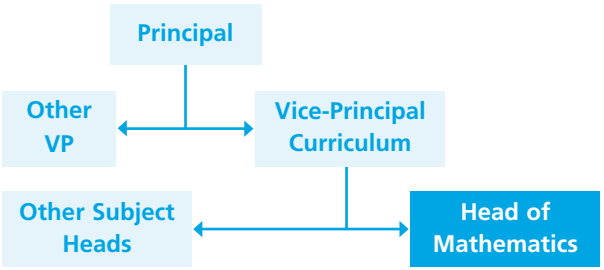
2.54 Often the best way to ensure good delivery of AoN within vocational courses is for mathematics specialists to work in teams with vocational specialists. This may involve some team-teaching, it may involve some coaching of the vocational specialists to improve their own numeracy, and it also should involve a significant input in the design and initial assessment of student assignments. An important task, which is best undertaken by vocational and mathematics specialists working together, is the mapping of activities in student assignments on to AoN criteria. It is also important to note this approach when considering the future success of functional mathematics.

Recommendation 14

The QIA and LSN should explore and promote, in consultation with the NCETM, models of good collaborative practice for the delivery of mathematics elements within vocational programmes. These should be used to inform the current delivery of Key Skills Application of Number and the future delivery of functional mathematics.

2.55 The position in some, but not all, SFCs is closer to that in schools. Many have a strong focus on A levels with the provision of some level 2 courses for those who need to complete their GCSE portfolio. The mathematics staff in these colleges may also have responsibility for the delivery of AoN.

2.56 The organisation and management of mathematics within a college is significantly affected by the position of the person responsible for mathematics in the college hierarchy. Some SFCs and schools are now moving towards faculty-type structures. The position of mathematics within a typical SFC is shown in the diagram below.



2.57 Variants on this diagram may include the Head of Mathematics being subordinate to a Head of Faculty, for example of Science, Computing and Mathematics. In either

case the Head of Mathematics will be responsible for at least GCE and GCSE mathematics. Numeracy within Skills for Life and AoN will probably be the responsibility of a Head of Learning Support, or Head of Key Skills. However, here, as in other types of college, it is important that there should be strong liaison between those responsible for teaching mathematics at all levels.

2.58 There are some managers in colleges in the further education sector who do not yet appreciate the importance of mathematics across many subject areas and vocational sectors, giving mathematics low priority in terms of its funding and profile within their colleges. A corollary of this is that in colleges mathematics can be hidden away, often with no clearly defined focus area. This creates a negative impression on students, as do drab classrooms and routine teaching (no better than satisfactory) that are often observed in inspections of mathematics in the further education sector.[16] Unlike clearly identifiable vocational sectors where initiatives such as Centres of Vocational Excellence (CoVEs) have raised the profile of a skill area or discipline there has been limited or no supportive funds for the development of mathematics. It also has to be recorded that colleges are not funded on a par with secondary schools with sixth forms, even when they deliver the same programmes.

Recommendation 15

We recommend the establishment of mathematics-based Centres of Vocational Excellence (CoVEs) to support the development of excellent provision across the whole range of mathematics offered in colleges, both vocational and academic. These would be linked with and supported by the new National Centre for Excellence in the Teaching of Mathematics (NCETM).

Not all managers have explored fully the range of qualifications on offer, and some are constrained by factors such as the manner in which their college is organised and mathematics is dispersed in their college, or by their perception of how external funding mechanisms impact on the choice of courses to promote.

2.59 On the positive side, the best colleges take a proactive approach to marketing mathematics to students and their parents. There is a well-defined mathematics suite of rooms in these colleges. Mathematics is presented in high profile and the classrooms are filled with interesting posters and models. The mathematics area is seen to be an area of active learning and stimulation. The use of ICT is much in evidence, both as a teaching tool and as a resource for students. Some colleges promote special events with guest speakers and get students to participate in local, national and even international contests or projects. They produce information about mathematics and careers involving mathematics in some form or another.

2.60 The best colleges make much effort to attract students to study mathematics and to ensure that students not only have a positive learning experience when studying mathematics, but that they develop positive attitudes to the subject and are well prepared for both higher education and employment. They work effectively with staff from across the institution. The mathematics offered underpins both vocational and academic development.

[16] *Evaluating mathematics provision for 14-19 year-olds. Ofsted, 2006*

3 Resources for improving teaching and learning

Mathematics areas

3.1 Several colleges mentioned that mathematics is seen as a subject that can be timetabled 'flexibly': because it is believed not to need resources, any room can be used for teaching mathematics. The most likely outcome of this is to promote negative attitudes towards the subject as unimportant, traditional and boring.

3.2 It has also proved difficult in many cases to establish a 'mathematics area' of classrooms dedicated to mathematics. Although there will also be accommodation pressures that colleges have to wrestle with, the aim should be to enable subject areas like mathematics to establish a strong sense of identity to which the students can relate, ensuring that mathematics rooms are well equipped and appropriately decorated with posters and displays that promote mathematics.

One Tertiary College has a large, dedicated mathematics department, with a clear and attractive focus area within the college. There are banks of computers and graphic calculators in the classrooms, quality posters about mathematics in the corridors and classrooms, a drop-in maths resource room and workshop permanently staffed throughout the week. There are also quiet worktables in the corridors between classrooms where students can work without interruption. There seemed to be a very positive approach to mathematics from the friendly, supportive staff and the purposeful study of students in classroom or in private study. ICT is used in mathematics lessons and students have permanent access to a range of good mathematics software. The college has close links with the local feeder schools and promotes mathematics via a mathematics challenge for Year 7 pupils; all the LEA schools send a team of four to a final at the College.

Information and Communications Technology (ICT)

3.3 The use of ICT has the potential to transform the teaching and learning of mathematics. This requires the application of a policy of identifying rooms for mathematics, equipping them with computers and interactive whiteboards, and also ensuring that other open access areas in the college have the same mathematics software as that held in the mathematics department.

3.4 None of the colleges interviewed were entirely satisfied with the ICT provision available to their students. Some colleges complained that their computers were obsolete and slow to use. Others had to book the room with computers, which

acted as a disincentive to plan lessons using software. However, several had made commendable efforts to enable the mathematics curriculum to be enriched by the use of ICT.

There are six classrooms, all of which have a PC for the teacher, with a ceiling-mounted projector in three of them. One of the classrooms is equipped with computers, which serves as a student drop-in room. Because teachers have regular access to a PC and projector, they use them as an integral part of their teaching.

3.5 There is also evidence of the increasing use of interactive whiteboards (IWBs) in colleges. However, in most colleges IWBs are not universally available, as they are in mathematics rooms of many schools. Students progressing to colleges therefore do not see the same level of technology used in colleges as in their previous school.

3.6 One focus group made the following observation: 'The use of ICT leads to better behaviour in the classroom and concentrates student attention more'. All those present in this group were strongly in favour of the use of ICT as a tool for learning mathematics.

3.7 Some colleges, SFCs in particular, have developed a sophisticated intranet facility for the mathematics students and for the staff.

At one SFC, the mathematics intranet site can be used by students to support independent learning and by staff to access database to log and record all students' performance.

'The Mathematics intranet site is maintained by all maths teachers, and each has a responsibility for a mathematics module. The site uses many in-house resources and also uses the Mathematics in Education and Industry (MEI) distance learning site.'

'All 'common assignments' and textbook worked solutions are available online.'

'The database is produced and maintained by the head of department for all staff to record test and assignment completion. This helps identify poor performance across the whole student base and enables effective 'ranking' across the classes. Scores can be recorded and 'graded' automatically. Students' details can be accessed easily by any teacher. Students' attitudes and perceptions about mathematics are recorded at different times throughout the course.'

3.8 New developments in the mathematics curriculum such as the FSMQ require the use of computers to build up student portfolios. Where Colleges are delivering FSMQs they have been able to lobby for computer resources as a necessary part of their curriculum.

3.9 For funding of mathematics resources in colleges, mathematics is not seen as a resource-intensive subject. As mentioned previously, it has not had the supportive funds for development seen by other areas of provision. Therefore it has proved difficult for mathematics departments to gain the ICT resources that they need.

Recommendation 16

Every college should have a well-defined area of the college dedicated to the teaching of mathematics and resourced with computers, software and other materials.

DfES Standards Unit resources to improve learning

3.10 A very welcome recent initiative has been the trialling and piloting of approaches to teaching and learning mathematics, and the development of resources exemplifying these, by the DfES's Standards Unit, now part of the Quality Improvement Strategy. This is part of the DfES's drive to improve teaching and learning in FE. The resource was disseminated nationally in September 2005. To support teachers in taking on board the approaches, the Standards Unit invited colleges and other providers to nominate 'subject learning coaches' in mathematics and is supporting these teachers through regional networks and a professional training programme.

An increasing number of colleges are using the Standards Unit resource *Improving Learning in Mathematics*. Some use the approaches successfully on courses at Levels 1, 2 or 3 and modify the materials as required, but use the same pedagogic approach to teaching the mathematics.

Some colleges engage in some sort of cascading CPD activity, led by a subject coach for mathematics.

One teacher said, 'We readily go into each others' classes to watch an unfamiliar topic being taught'.

3.11 The materials are designed to foster active engagement by students in the learning process, and in mathematical thinking, by using techniques for problem solving that require student participation. Most respondents had been to an event related to the Standards Unit materials, and there was unanimous praise for the quality of the materials. The recent Ofsted report evaluating mathematics for 14- to 19-year olds recommended that the DfES:

'continue to invest in the dissemination of the successful approaches to teaching and learning developed through the Standards Unit's framework for mathematics, with particular emphasis on collaborative professional development across mathematics departments.'[17]

Recommendation 17

There should be continued investment, through the NCETM, in the Framework for Mathematics originally produced by DfES's Standards Unit, now part of the Quality Improvement Strategy for the learning and skills sector.

A major role for the NCETM is to support the embedding of this approach.

[17] *Op. Cit.*

3.12 Good materials are an essential prerequisite for good teaching. What is new about the Standards Unit materials for mathematics is that they quite deliberately foster an active mode of learning, while many materials, even of apparent good quality, may not. Some college staff identified module specific textbooks as a barrier to good pedagogy. They felt they encouraged 'teaching to the test' and a narrow focus on examination requirements. Teaching to the test was highlighted as a key issue in the recent Ofsted report[18].

Recommendation 18

The design of mathematics textbooks and resources should learn from the DfES's Standards Unit approach exemplified in *Improving Learning in Mathematics.*

New developments

3.13 It is important for managers and mathematics subject leaders in FE colleges to be aware of two highly significant developments in the field of mathematics.

3.14 The MEI Further Mathematics Network consists of 46 Further Mathematics Centres (FMCs) throughout England. They have been set up with the support of the DfES to establish provision for AS and A Level Further Mathematics that will enable all schools and colleges in an area to offer Further Mathematics tuition to all their students who would benefit from studying mathematics to this level. Study will be provided to the students in their own school/college or through the local FMC (or a mixture of both). The FMCs will support teachers and students in schools or colleges and forge links with the local education establishments, including the local universities. A strategic purpose of the FMCs is to provide students with a degree of challenge and stimulation with a view to increasing take up of mathematically rich subjects at university. More information about the Further Mathematics Network can be found at **www.fmnetwork.org.uk**

Recommendation 19

All colleges, and especially General Further Education (GFE) colleges where A Level Mathematics provision is particularly vulnerable, should do more to promote advanced mathematics by becoming partners in their local Further Mathematics Network.

3.15 A further important development is the establishment by the government of the National Centre for Excellence in the Teaching of Mathematics (NCETM), launched officially in June 2006. **More information about the NCETM can be found at www.ncetm.org.uk**

Recommendation 20

The NCETM should encourage the LSC and the AoC to bring to the attention of principals and college managers the planned activities of the NCETM and work actively with the NCETM to ensure that colleges are fully represented in these activities.

[18] *ibid.*

4 The mathematics teaching force in colleges

Initial Teacher Training in Education (ITTE)

4.1 At present there are three main routes to initial teacher training for those wishing to teach mathematics in the FE sector. The first is to follow a PGCE in mathematics education for the secondary age range, which, in addition to qualifying them to teach in a school (with Qualified Teacher Status, QTS) will also qualify them to teach in the FE sector. These courses are usually full-time courses and are undertaken before starting to teach. They are mainly university-based with the main professional practice period taking place in a school, but can be based in consortia of schools. Part of the professional practice may be spent in a college.

4.2 The second route is via a school-based Graduate Teacher Programme (GTP) scheme, which provides QTS without a PGCE qualification while the trainee is employed by the school. There is an anomaly between how those who opt to work in Sixth Form Colleges and General FE Colleges are treated in gaining QTS status through the GTP route: SFCs are treated as schools whereas GFE colleges are not. Those working in SFCs can therefore gain QTS status by undertaking a successful three-week school-based placement in addition to being assessed in relation to their work in the College. However, those working in the GFEs are unable to gain QTS status through the GTP route without leaving employment and working in the school sector. This seems inconsistent as a GFE college will often provide a wide range of teaching opportunities and may well include 14- to 16-year old students.

Recommendation 21

General FE Colleges should be recognised in addition to Sixth Form Colleges as suitable bases for a probationary period in mathematics teaching leading to Qualified Teacher Status.

4.3 The third route is the PGCE (FE) route in which student teachers are trained to teach in the FE sector. These courses are often part-time and in-service and qualify staff to teach in FE colleges but not in schools. Ofsted surveyed PGCE (FE) courses in 2003, and made the observation that 'few opportunities are provided for trainees to learn how to teach their specialist subjects'[19]. This observation was confirmed by some respondents who had recently qualified as FE teachers.

[19] The Initial Training of Further Education Teachers – A Survey. HMSO, 2003, page 2.

4.4 At present there are many PGCE (FE) courses across the country, some delivered in HE institutions and others in FE colleges validated by an HE institution. This means that teaching groups are often very heterogeneous, which is one of the reasons why there is so little focus on subject specialisms. For those undertaking the part-time route while in employment, there should be support from subject mentors in the workplace. But the Ofsted survey concluded that 'Few trainees receive effective mentoring in the workplace, and their progress is inhibited by insufficient observation and feedback on their teaching.'[20]

Recommendation 22

We recommend the establishment of specialist PGCE (FE) courses in mathematics. In each region of England one Centre for Excellence in Teacher Training (CETT) would be chosen to have the lead responsibility for the training of mathematics teachers in FE colleges. These centres should be linked with the regional centres of the NCETM and it would be appropriate, where possible, to link this with the more general Centre of Vocational Excellence (CoVE) status in Mathematics (see Recommendation 15).

4.5 An additional issue highlighted by the Ofsted report is the level of mathematical skills held by staff entering the sector. Ofsted found that a third of all trainees for the generic FE PGCE who were surveyed lacked level 2 qualifications in numeracy at the start of their course[21]. Given the fact that in many colleges much of the provision of Application of Number is made by teachers with a vocational specialism, this is concerning. Before PGCE students in the school sector can enter the course, whether primary or for any secondary subject, they must have a GCSE-equivalent qualification in mathematics, and to gain QTS they are required by the TDA to pass further online tests in numeracy, literacy and ICT.

4.6 Lifelong Learning UK (the Sector Skills Council for this sector) is currently developing new standards for newly qualified teachers in the sector. As part of the process for qualifying as a teacher in the FE sector we endorse the development of tests in literacy and numeracy for teachers in the FE sector. As well as ensuring teachers within the sector have the requisite skills themselves, consideration is also needed as to how they will teach and embed these within their own subject area.

Recommendation 23

We recommend that the new standards for teachers in the lifelong learning sector should include a requirement that qualified teacher status cannot be achieved unless a level 2 qualification in numeracy is possessed by the FE teacher. The new standards should also require a teacher to demonstrate how they can embed functional mathematics in their specialist area.

[20] *ibid*, page 3.
[21] *ibid*, page 2.

Subject knowledge

4.7 In general the subject knowledge of those teaching GCSE and A level mathematics in SFCs was good. Most of the staff had degrees in mathematics, or in a highly mathematical subject like Physics.

4.8 The statistics available from the Further Education Workforce data do not allow a detailed picture of the qualification levels of teachers in mathematics to be identified.[22] There are two reasons for this. Firstly, mathematics is subsumed under "science and mathematics". Secondly, the statistics merely show how many individuals in a given sector possess a 'Professional qualification – first degree, further degree and above'. The data show that in this combined sector 86% of the members of staff have a professional qualification. The only sector with a higher percentage is Humanities at 89%. The percentage for the whole sector is 66%.

Recommendation 24

We recommend that suitable incentives should be put in place to encourage all relevant staff in the college sector to gain professional qualifications in mathematics.

Knowledge and use of ICT

4.9 Knowledge and use of ICT appears to be variable across the sector. Some of the staff who were interviewed were confident and regular users of ICT, with the package *Autograph* being the one most commonly in use. Those staff teaching the AS Use of Mathematics and FSMQs used ICT frequently as it was part of the assessment of the qualification. In some instances staff had improved their own ICT skills alongside their students. However, in one of the colleges mathematics software was not used. In this college neither were graphics calculators available for students, because it was felt that the college would not resource them.

4.10 There was a strongly expressed opinion that college funding mechanisms are still regarding mathematics as a subject that needs very little resourcing. Without ICT being effectively integrated into the assessment of a qualification some staff felt there was little or no incentive to use ICT or for college managers to invest in it.

4.11 It is clear that a major task of the NCETM will be to encourage high quality in-service training on the use of ICT packages and Interactive Whiteboards in mathematics teaching.

Opportunities for CPD

4.12 College management should be concerned to ensure that they can enable their staff to engage in appropriate programmes of Continuing Professional Development (CPD), but this is not always the case in reality. It is inevitable that colleges will be judged increasingly on the extent and effectiveness of the CPD programmes undertaken by their staff.

4.13 A common concern of many of the staff interviewed for this study was that much of the CPD offered internally is about generic issues (quality, child care, health and safety, etc.)

[22] *Further Education Workforce Data for England – an analysis of SIR data 2003/04.* Published by Lifelong learning UK. 2005.

These are perceived by the staff as priorities for the senior management team, which often does not appear to regard developing the curriculum and pedagogy as meriting the same degree of importance. Training to enhance the capability of the staff to deliver the core product of the college is thus regarded as less important than meeting the accountability demands that external agencies place upon the college. This may of course be a misinterpretation but the perception is strongly held.

4.14 Despite this dissatisfaction about many colleges' overarching CPD programmes, there are examples where mathematics staff feel that they have been able to access the CPD that they need. Staff in some institutions, for example, have had access to level 3 and level 4 numeracy teaching qualifications.

Recommendation 25

All those who are specialist numeracy teachers should gain a level 4 qualification in teaching numeracy. In addition, we feel that where teachers from another specialism teach a significant amount of Key Skills Application of Number they should be encouraged to gain at least the Level 3 Numeracy Teaching Qualification.

4.15 Many of the examples of CPD cited, however, relate to attendance at awarding body events and one-day courses. In a few instances, staff discussed collaborative practice events held both internally and externally. However, it is clear that at present there is limited awareness of what constitutes CPD and limited access to such opportunities.

Recommendation 26

The NCETM should play a lead role in raising awareness of what constitutes sustained CPD. It should recommend to LLUK the proportion of the new CPD entitlement for teachers of mathematics within the FE sector that should be subject specific. It should also clearly identify and kite mark opportunities for sustained CPD.

Recruitment and retention

4.16 A major issue for the college sector is the pay of staff. The disparity with schools in pay, promotion prospects and conditions is of great concern to colleges. The salaries of teaching staff in the college sector have compared unfavourably with those of school teachers for some years. This effect is more marked in GFEs than in SFCs. One respondent estimated that members of staff in GFEs earn on average £5000 a year less than their counterparts in SFCs.

4.17 Many staff were concerned about the impact of this on the recruitment and retention of staff.

4.18 One college reported that it had received only two reasonable applications for their most recent post; fortunately they were able to make a good appointment.

5 Identifying and Implementing good practice

Identifying good practice

5.1 One of the purposes of this project was to try to collect examples of good practice around the delivery and organisation of mathematics within the FE sector. We have asked teachers and managers to suggest examples of what they consider to be good practice within their institutions, or institutional networks. Some of these have already been identified throughout the report.

5.2 Usually, it is a combination of factors that result in good practice. Teachers and managers in colleges have to think creatively and be proactive to change things for the better. Good practice does not simply happen of its own accord, as the quotation from the Ofsted report on practice in a particular college shows. This extract makes clear the sorts of things that Ofsted inspectors consider contribute to good practice.

'Teaching and learning in mathematics are very good. Teachers use very effective strategies in mathematics lessons, exploiting well the DfES standards unit national pilot material in activity-based learning. For example, in an advanced mathematics lesson, IT and Standards Unit materials and approaches were used very effectively to introduce the geometry of the circle. The active learning approach to teaching is transforming and revitalising learning. Lesson planning and schemes of work in mathematics are good, providing a sound basis for teaching and learning. In the best lessons, a wide range of learning activities challenges all students. Often, there is exceptional use of ICT in lessons. Students are well motivated and ask questions which display interest and understanding.

'Very good leadership in mathematics has successfully embedded the innovative activity-based approach in all programmes.'

From an Ofsted report on a college

5.3 Less effective practice may arise for several reasons. Sometimes, it is merely because those responsible for organisation of courses within their colleges have not appreciated the overarching significance of mathematics across different areas of activity, precisely because their organisational structures allow mathematics to remain hidden so that it seems a low priority area. External pressures, such as funding mechanisms, may inhibit good practice. Tensions arise also from conflicting demands of different government agencies, which pull colleges in different directions simultaneously.

Implementing good practice

5.4 We present here a case study of one GFE interviewed which received an outstanding Ofsted report for mathematics. This is of interest because it highlights the range of provision on offer, the style of organisation well-suited to the delivery of mathematics across the college, the curriculum innovation by the mathematics team and the commitment to staff development, as well as students' success.

COLLEGE 1

Structure of provision

The vast majority of teachers of mathematics and numeracy are managed in the Mathematics and Numeracy Programme area which extends across the whole college. There is an Adult Numeracy coordinator with a brief for Adult Numeracy across the College's many sites in the Borough. She and the Head of Programme work very closely together on issues such as course planning, rooming, resourcing and staff development. There is, in addition, a number of staff with small amounts of remission to coordinate particular qualifications. There are, inevitably, a number of part time teachers, especially in less central sites, who are managed within different areas, but all teachers of mathematics and numeracy are part of a well-defined network which actively seeks to encourage the sharing of good practice.

- The feature which is probably most unusual is that all teachers teach mathematics and numeracy across a range of levels from Entry to A level. This is deliberate and planned and is made very clear to applicants for posts.

Scope of Provision:

AS & A2 Further Mathematics (MEI): 1 group each

AS & A2 Mathematics (EDEXCEL): 6 AS and 3 A2 groups

AS in Use of Mathematics (AQA): 2 groups

GCSE for 16-19 year olds (EDEXCEL): 11 groups

GCSE for adults day and evening: 8 groups

Pre-GCSE mathematics: 2 groups

FSMQs for 16-19s (AQA): 15 groups Managing Money, 4 groups Making Sense of Data, 3 groups Working in 2 and 3 Dimensions, range of different vocational areas

Entry level mathematics for ESOL learners (16-19 and adult): 12 groups

Entry level mathematics for pre-vocational students: 8 groups

Use of new qualifications

- The programme area has been very proactive in adopting curriculum innovations over the years and this has contributed to the high quality of teaching and learning observed by Ofsted. For example, we introduced the AS in Use of Mathematics in addition to the traditional A level and this meant that a number of teachers had to become proficient in the use of ICT with students at this level – this had a wider impact.

- For young people we have avoided where possible using the Key Skills qualification, preferring to make use of the FSMQs at level 1. These allow for vocational contextualisation of mathematics within a mathematics curriculum and assessment regime which is much more engaging than Key Skills. Although the FSMQs are not a proxy for KS it seems that they are acceptable as 'working towards' which is what the LSC seems to require. The adoption of FSMQs also enabled the mathematics department to argue for dedicated maths IT facilities. Many FSMQ students also take the Adult Basic Skills National tests; these are now largely done on-line.
- Critics often suggest that our organisation of mathematics works against the common aim of situating the learning of mathematical skills in vocational contexts – this is indeed made easier if the maths is taught by vocational specialists. However, in practice this rarely happens and it is often just badly taught and contributes to students' negative attitudes to further learning. The use of FSMQs is genuinely motivating and introduces students to real functional mathematics skills and applications such as the use of spreadsheets.

Pilot centre for Standards Unit *Improving Learning in Mathematics* project

- Our involvement with the Standards Unit team, as a trial-centre and then as one of 40 centres in the National Pilot has been highly significant. The materials and the philosophy underlying the approach are extremely well-thought-out and attractive for teachers to implement. While the initial work was mainly done with level 2 and 3 learners, the fact that these teachers were also engaging with learners at other levels made it inevitable that they would also try out the approaches in these other areas. Hence the ideas 'cascaded' very quickly and effectively. A number of substantial staff development sessions have been organised with members from the SU team. These have included teachers from local schools, as well as all these in the college who teach mathematics and numeracy.

Maths4Life

We are now a pilot site for the Maths4Life 'Thinking Through Mathematics' project which seeks to extend the Standards Unit approaches to learners at levels 1 and below. We have also contributed to small pathfinder projects for Maths4Life.

CPD

The college as a whole makes a major commitment to staff development and has been generous in its funding of staff for many of these initiatives. The College also recognises the historic difficulties of recruiting and retaining good teachers of mathematics and has provided full support for the structures outlined above.

5.5 A second case study shows how an SFC interviewed in an area with extremely poor Key Stage 4 results has begun to turn things around at the post-16 level. Again, this college received an outstanding Ofsted Report for mathematics.

COLLEGE 2

In the Mathematics department there are 7 members of staff, 2 of whom are part time. We offer a wide range of courses from Open College units at Entry level to Further Maths at A level. We also work with our 11 – 16 partner schools through the gifted and talented funding.

We were concerned that curriculum 2000 would result in numbers falling, results dropping and those with an intermediate level GCSE grade C being dissuaded from enrolling onto AS Mathematics. Therefore the head of department (HoD) embarked on a review of teaching approaches. The review led to the development of a new approach, which had a strong emphasis on active learning. The key characteristics of the new approach are encouraging students to discuss, explain and reflect, enabling students to see the connections in Mathematics and encouraging students to have a go and take risks.

The HoD developed a range of activities that provoked discussion and thinking including card sorting, making posters and the use of open questions and trialled them with her classes. The results were very encouraging and she ran CPD sessions with the rest of her staff who were all keen to take this approach on board.

The following year this approach was extended to all other Mathematics courses run by the department. The HoD again ran CPD sessions internally and this time they focused on enabling teachers to write and produce their own activities. Banks of suitable activity ideas are now available in college.

Numbers of students wanting to enrol on AS Maths is now at an all time high. It is the second most popular AS level in the college (behind only Psychology). We accept many students onto the course with an intermediate grade C at GCSE and feel that we offer them a very realistic chance of success. Students are enjoying learning Mathematics and many are continuing onto A2. This has caused us a few problems as students who work hard and just manage to gain a grade E at AS level are staying on and wanting to do A2, which is providing us with an exciting challenge. Also we have students who come with a GCSE grade D or E, retake their GCSE with us, gain a grade C and then want to move onto AS Mathematics. The other knock on effect is that Further Mathematics numbers are increasing each year.

The HoD was asked by the Standards Unit to write materials and train teachers in this approach as part of the 'Improving Learning in Mathematics' project. This has enabled us to make links with many other institutions and interested bodies. Currently the HoD is doing the same for the Maths4life Effective Practice project and the college is also a pilot site for this project.

We had reached the stage whereby around 20% of our A2 cohort wanted to go onto study Mathematics or a course involving a very high percentage of Mathematics at university. Unfortunately the Mathematics department at our local university has closed and most of our students want to stay in the city. Sadly, we are losing potential Mathematics graduates as they are applying to study alternative subjects rather than move away from the city.

5.6 Good practice invariably depends on good leadership in mathematics, but for this to flourish it has to be supported by good management structures. As noted in Chapter 2, mathematics can be so hidden away in other programme areas of the college that often even senior managers are unaware of its existence and there is no locus of responsibility to improve this unsatisfactory state of affairs. This leads a significant number of colleges to disperse their mathematics staff and dissipate expertise from a recognised mathematics team to disparate vocational areas around the college. Several colleges in this study now have no recognised Head of Mathematics, where once they did. In such colleges, mathematics specialists soon lose their identity and begin to function in isolation.

5.7 SFCs have Heads of Mathematics, as generally do TCs. There is much more variability, however, in GFEs. Mathematical good practice is seldom observed in GFEs without a person with coordinating responsibility for all or most of the mathematical activity within a college. Where there is such a post of responsibility, members of staff in different programme areas are more likely to be encouraged to work together, share ideas, develop common curriculum materials, and sometimes even co-teach. This, in the longer term, makes for better all round teaching and provides a more satisfactory experience for students. In the best performing colleges, mathematics staff often teach across the board (sometimes sharing vocational classes with their vocational colleagues) – AoN, GCSE, GCE, FSMQs, in certain vocational areas, engineering and so on – and are enriched in their knowledge of mathematical application and in their pedagogic experience. The very diversity of the teaching is a positive and rewarding challenge for these teachers.

5.8 A mathematical community of teachers sharing knowledge, wisdom and experience has to be better than a set of individuals working in isolation.

Recommendation 26

Every college should ensure that one person has the responsibility for coordinating all mathematical activity across the college. This person should also be in charge of continuing professional development (CPD) for all teachers of mathematics, to ensure the sharing of good practice, subject knowledge and pedagogy. S/he should also act as a link to regional mathematics centres.

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Appendix

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The Bournemouth and Poole College (GFE)
The College of West Anglia (GFE)
Tower Hamlets College (GFE and SFC)
West Cheshire College (GFE)
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Other sources of evidence and information

AoC's College Principals' Mathematics Group
Adults Learning Mathematics
Association of Teachers of Mathematics
British Society for the History of Mathematics
Heads of Departments of Mathematics
Institute for Mathematics and its Applications
London Mathematical Society
Mathematical Association
National Association for Numeracy and Mathematics in Colleges

Acronyms and abbreviations

ABSN	Adult Basic Skills Numeracy
ACME	Advisory Committee on Mathematics Education
AEA	Advanced Extension Award
AoC	Association of Colleges
AoN	Application of Number
AQA	Assessment and Qualifications Alliance
AS	Advanced Subsidiary
BTEC	Business and Technology Education Council
CETT	Centre for Excellence in Teacher Training
CoVE	Centre of Vocational Excellence
CPD	Continuing Professional Development
DDP	Diploma Development Partnership
DfES	Department for Education and Skills
FE	Further education
FEFC	Further Education Funding Council
FSMQ	Free Standing Mathematics Qualification
GCE	General Certificate of Education
GCSE	General Certificate of Secondary Education
GFE	General Further Education college
GTP	Graduate Teacher Programme
HE	Higher education
HoD	Head of department
ICT	Information and communication technology
IT	Information technology
ITTE	Initial Teacher Training in Education
JMC	Joint Mathematical Council of the UK
LEA	Local Education Authority
LLUK	Life Long Learning Sector Skills Council
LSC	Learning and Skills Council
LSN	Learning Skills Network
MEI	Mathematics in Education and Industry
NCETM	National Centre for Excellence in the Teaching of Mathematics
NIACE	National Institute for Adult Continuing Education
NVQ	National Vocational Qualification
OfSTED	Office for Standards in Education
PGCE	Postgraduate Certificate in Education
PSA	Public Service Agreement
QCA	Qualifications and Curriculum Authority
QIA	Quality Improvement Agency
QTS	Qualified Teacher Status
SC	Specialist and specialist designated college
SFC	Sixth form college
SSA	Sector Subject Area
TC	Tertiary College
TDA	Training and Development Agency for Schools
VP	Vice principal
VRQ	Vocational Related Qualification

ACME and Royal Society / JMC mathematics education reports

Making Mathematics Count – Two Years On
(30 page report of an ACME conference, June 2006)*

'14–19 Mathematics Pathways'
(12 page report of an ACME workshop, December 2005)*

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(24 page report of a feasibility study, July 2005)*

Assessment in 14–19 Mathematics
(12 page report of ACME's second self-initiated project, January 2005)*

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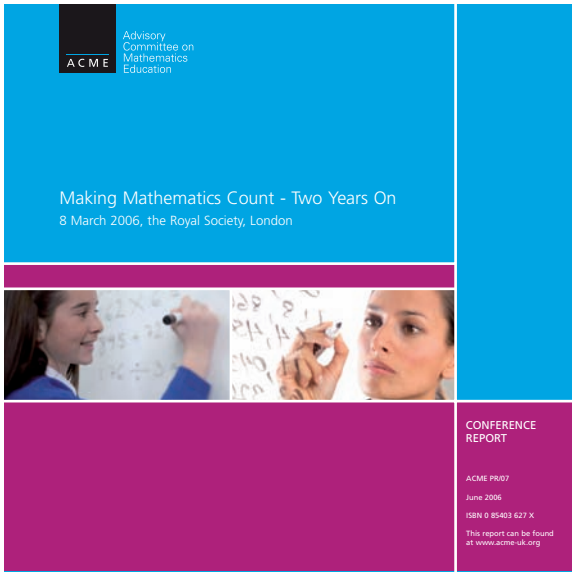
(15 page report of ACME's first self-initiated project, December 2002, 2 page summary also available)*

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

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:
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This report was reviewed by a panel chaired by Professor Martin Taylor FRS, Vice President, the Royal Society, and including Professor Patrick Dowling FRS, Chair of the Royal Society's Education Committee and Professor Bernard Silverman FRS, Chair of the Joint Mathematical Council of the UK.

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