REPORT
FROM THE
INSPECTORATE

Curriculum Area
Survey Report

March 1998

Sciences

THE
FURTHER
EDUCATION
FUNDING
COUNCIL

THE FURTHER EDUCATION FUNDING COUNCIL

The Further Education Funding Council has a legal duty to make sure further education in England is properly assessed. The FEFC's inspectorate inspects and reports on each college of further education every four years. It also assesses and reports nationally on the curriculum, disseminates good practice and gives advice to the FEFC's quality assessment committee.

Cheylesmore House
Quinton Road
Coventry CV1 2WT
Telephone 01203 863000
Fax 01203 863100

SUMMARY

The science programme area is, jointly with health and community care, the third largest of the 10 programme areas of the Further Education Funding Council (FEFC), after humanities and business. The science programme area covers mathematics, computing and information technology as well as science subjects. In addition to science subjects such as biology, physics and chemistry, it includes specialist areas such as opthalmics, environmental health and veterinary science. The range of qualifications available to students is diverse and includes vocational as well as general education qualifications.

Many colleges offer students an extensive choice of courses which generally meet their needs. Too many students, however, continue to take a general certificate of secondary education (GCSE) mathematics course rather than an alternative course in mathematics which would suit them better. Science subjects have declined in popularity over recent years and the development of courses leading to general national vocational qualifications (GNVQs) in science has been slow. There has been substantial growth in the number of modular general certificate of education advanced/advanced supplementary level (GCE A/AS level) courses. Colleges have been imaginative in devising ways of meeting a growing demand for computing and information technology courses. The key skills element of GNVQs and other vocational programmes means that information technology and numeracy form important components of courses in other programme areas.

The teaching time devoted to courses varies considerably. The time allocated is determined more by resource considerations than by curricular requirements. Although students are able to supplement formal lessons with private study at home and in colleges' learning resource centres, they often receive insufficient support from college staff to make the best use of the learning resources available to them.

The quality of course management varies. Some colleges fail to ensure a consistent approach to the planning and teaching of mathematics and science subjects across the college. The management of information technology provision is more effective and a number of colleges have responded imaginatively to the proposals of the learning and technology committee, chaired by Sir Gordon Higginson. Quality assurance procedures vary widely in their effectiveness.

The quality of teaching and learning is broadly in line with that of other programme areas. There are many examples of well-planned courses and lessons and of lively, innovative teaching to which students respond enthusiastically and productively. There is a substantial, though smaller, volume of less imaginative teaching which barely addresses students' needs. In general, theory lessons tend to be less successful than practical sessions. Arrangements to provide students with additional support are not always well implemented.

Levels of punctuality and attendance tend to be lower on one-year full-time courses than on other programmes. Many students display a sound understanding of their subject and are developing good analytical and practical skills. However, science, computing and mathematics students often display weak numerical and algebraic skills. GCE A/AS level and GCSE pass rates are generally higher in sixth form colleges than in other sector colleges. Pass rates for GNVQ courses in science and information technology vary according to level but the proportion of students obtaining the full award within the normal period of study is, generally, less than 50 per cent. Pass rates on BTEC national diploma courses are substantially higher. Even where course pass rates are satisfactory, low completion rates often mean that fewer than 50 per cent of students who enrol on a course obtain the full qualification.

Most teachers are well qualified in their subject and committed to their work. Many colleges rely significantly on part-time teachers but do not always manage their work effectively. Increasingly, technical support staff are being required to act as instructors and in some colleges, there is a lack of technical support. Many colleges have invested heavily in computing equipment and in learning resources, yet science and mathematics students often do not have access to appropriate specialist software. There are not enough computer workstations in most of the classrooms in which mathematics is taught. In many colleges, science equipment is serviceable but old. The quality of library stock varies and is poor in some cases. Some colleges have good facilities to support students with disabilities. Much of the accommodation used for computing and information technology is of high quality. Most mathematics classrooms are fit for the purposes for which they are used. There are examples of modern, carefully designed, purpose-built science laboratories. Equally, the laboratories in some colleges are old and their layout restricts the range of uses to which they can be put.

CONTENTS

INTRODUCTION

1 This report is based on inspections of computing, mathematics and science carried out as part of the programme of college inspections between 1993 and 1997. Inspectors observed over 12,300 teaching sessions, involving approximately 135,000 students, and awarded over 500 inspection grades. Inspection grades for lessons and for curriculum areas are summarised in annexes C, D and E. Between January and May 1997, inspectors revisited 20 colleges in order to build up a detailed picture of how particular colleges organise and manage information technology and mathematics provision across the curriculum. They also investigated how colleges support students who struggle with these subjects and inspected specialist science subjects.

2 The science programme area is, jointly with health and community care, the third largest of the 10 programme areas of the Further Education Funding Council (FEFC). It represents 14 per cent of enrolments in the sector. This compares with humanities (22 per cent) and business (17 per cent). Annexes A and B give details of enrolments and the subjects covered in the programme area.

Size and Scope of Provision

3 Many colleges have computing and information technology courses which address the needs of a wide variety of students. There are courses leading to general national vocational qualifications (GNVQs) in information technology at foundation, intermediate and advanced levels, BTEC national diplomas and certificates in computer studies and information technology, general certificate of education advanced advanced/supplementary levels (GCE A/AS levels), general certificate of secondary education (GCSE), and accreditation for access to higher education. In addition, there are courses such as City and Guilds of London Institute (C&G) 7261, which offer a variety of modules at different levels, including computer programming, and courses leading

to national vocational qualifications (NVQs) in information technology. Colleges have been innovative in meeting a growing demand for computing and information technology courses. Many courses are offered in collaboration with local schools, universities and employers and lessons are often arranged at times that will suit students' differing needs. Although a number of colleges have successfully attracted women to computing and information technology courses, the majority of students are men. Many students whose main area of study is not computing or information technology develop their information technology skills through courses leading to qualifications such as the RSA Examinations Board (RSA) diploma in computer literacy and information technology.

4 The range of courses leading to qualifications in mathematics and numeracy varies with the type of college. Many sixth form colleges offer only GCSE and GCE A/AS level courses, whereas most general further education and tertiary colleges also offer mathematics and numeracy courses accredited by bodies such as open college federations and the C&G. Such courses can provide a useful starting point for students who may not have studied mathematics for many years and lack confidence in their ability to cope with the subject. They are also more appropriate than GCSE mathematics courses for many of the 16 to 19 year olds who end up studying for GCSEs.

5 The number of students taking modular GCE A/AS level mathematics courses has increased significantly over the past two years. More than 80 per cent of the colleges in which mathematics was inspected in 1996-97 offered modular GCE A/AS level courses. Students welcome the flexibility and choice which modular courses provide. Modules in pure mathematics, mechanics and statistics are commonly available. However, only sixth form and tertiary colleges usually offer modules which lead to a GCE A/AS level further mathematics qualification. The shift to modular GCSE mathematics is less pronounced.

6 Mathematics and information technology are essential components of most vocational courses. For example, some national diploma and national certificate courses contain mathematics and information technology modules which students must pass to gain the award, and GNVQ programmes require students to develop numerical and information technology skills in a vocational context. Sir Ron Dearing's *Review of Qualifications for 16–19 Year Olds* recommended that GCE A/AS level syllabuses should explicitly focus on developing relevant numerical and information technology skills together with communication skills.

7 As well as biology, chemistry, physics and geology, science subjects include specialist areas such as medicine, veterinary work, health and hygiene, sports science and the environment. Just over 40 per cent of FEFC-funded science enrolments are in GCE A/AS level and GCSE subjects. The remainder are in vocational programmes. There are also science modules in a number of curriculum areas including hairdressing, beauty therapy and catering. The range and volume of science provision varies widely across colleges.

8 Science has declined in popularity over recent years in spite of the spread of modular provision GCE A/AS level courses. The development of GNVQ science programmes has been slow and some colleges do not believe they address the needs of industry as effectively as BTEC first and national courses. The decline in the number of part-time science students is due largely to the increasing unwillingness on the part of employers to sponsor their employees. Although there are a large number of science NVQs, colleges offer relatively few courses leading to such qualifications. Some industrialists and college managers consider that science NVQs lack academic rigour and are of value only to those involved in routine work. Science-based industries appear to be moving increasingly towards recruitment at graduate level.

Links with Other Organisations

Schools

9 The effectiveness of the links between colleges and schools depends heavily on the nature of the school and the drive and enthusiasm shown by staff in the two institutions. Where a school caters for 11 to 16 year-old pupils, the relationships between college and school staff are frequently good. College staff often organise events for pupils aimed at promoting the college and its courses. Nevertheless, only a few colleges work jointly with schools to develop the curriculum. Some college staff do not assign much importance to liaison work with schools, even when they are experiencing difficulty in meeting enrolment targets. Some colleges fail to appreciate the value of good links with schools in helping students cope with the transition from GCSE to GCE A/AS level study.

> One of the science teachers in a tertiary college organised a day-long event for local year 9 pupils who played the role of detectives in solving a murder. The pupils were required to apply scientific tests to a set of clues left by the murderer. They were assisted in their investigations by college students who had attended the same school. A questionnaire completed by the pupils and the animated way they spoke about their day showed it had been most successful. Many of them formed a favourable view of the college as a place where they might later continue their studies.

Higher education institutions

10 The effectiveness of links between colleges and higher education institutions varies widely. Some colleges have good working relationships which facilitate students' progression to degree or higher diploma programmes.

In a large sixth form college, additional courses are offered to enhance the GCE A level programme. These include courses in pharmaceutical and biomedical sciences, which are accredited by the Open College Federation. A local university allows students who have successfully completed these courses to enrol on specific higher education programmes with a lower GCE A level points score than would normally be required.

Industry

11 Colleges offering vocational courses in specialist science subjects or vocational computing courses often have productive links with employers in associated industries. In many colleges, however, links between science, mathematics and computing staff and employers are relatively weak. Although employers offer students work experience opportunities, they play little part in developing the curriculum or assessing students' work. This lack of contact with employers makes it difficult for students to put their studies into a work context.

CURRICULUM

Organisation

12 Many students combine subjects from the science programme area with other subjects to form their programme of study. For example, GCE A/AS level students often combine one or two of these subjects with GCE A/AS level subjects from other programme areas or with an advanced GNVQ programme. Many students aged between 16 and 19 who are studying for other general education or vocational qualifications take GCSE mathematics to improve their grade. Over 80 per cent of colleges inspected in 1996-97 made provision for such students.

13 Most colleges require GCE A level mathematics students to have at least a grade C in GCSE mathematics, or higher if a student wishes to take further mathematics. Students who want to take GCSE mathematics often do not have to meet formal entry criteria. Many of those who embark on GCSE mathematics courses, particularly adults, do so without sufficient guidance from the college. They become disheartened by the pace and difficulty of the course, and often leave before the end. More suitable numeracy courses and mathematics courses are often not brought to students' attention during enrolment. However, there are a few colleges which take great care to place students who have experienced difficulty with mathematics on an appropriate course.

> A tertiary college strictly controls entry to its various mathematics and numeracy courses. Students who want to resit GCSE mathematics must already have obtained a grade D. Students with a GCSE pass at grade E begin at level 4 of a numeracy course and students with a grade F begin at level 3. Careful course planning and timetabling enables students to progress easily.

14 In many colleges, students can choose from a wide range of GCSE and GCE A/AS level courses in science subjects. Some decide to study two or three GCE A level science subjects. A larger number of students combine one science subject with other non-science subjects. Overall, biological sciences are the most popular GCE A/AS level subjects, followed by chemistry and then physics.

15 GNVQ and BTEC national diploma science programmes include the main science subjects and units to develop key skills. Equivalent courses in information technology require that students understand, use and manage computerised systems and may include computer programming. In some colleges, students following vocational courses in science, computing or information technology can take additional

modules in subjects such as business in order to improve their prospects of employment or to help them gain a place in higher education. However, less than 10 per cent of students on vocational courses take such modules. Students on vocational science courses who wish to strengthen their chances of progressing to higher education often study a GCE A/AS level science subject. Although relatively few students on GCE A/AS level programmes take additional vocational course modules, some take additional courses designed to develop their key skills.

16 Many courses in mathematics, science, computing and information technology can be studied part time. In sixth form colleges this frequently involves part-time students joining groups of full-time students, often with little additional support. Some colleges offer distance or open learning provision for students who are not able to attend college regularly. Across the sector as a whole, however, such provision is underdeveloped.

17 There are significant variations between colleges in the teaching time allocated to courses (table 1). Most full-time students taking a GCE A level are timetabled for five hours each week; for GCSE the figure is four hours. The widest variations are found on vocational courses and access to higher education programmes. Often, the time allocated to courses is determined more by resource constraints rather than curricular needs. Some colleges compensate for what they perceive to be a lack of teaching time by providing work for students to tackle on their own with support from their teachers at set times during the week. Approximately 20 per cent of colleges inspected in 1996-97 used study packs and worksheets to help students prepare for GCE A level and GCSE examinations. Many general further education and tertiary colleges have paper-based learning resources to enable mathematics students to study mainly at home; a few colleges have similar materials available for science students. Sixth form colleges have been slow to develop such resources. Where they have been developed, there is often insufficient support from tutors to enable students to make the best use of the materials.

Table 1. Teaching hours

Course	*Hours a week*		
	Minimum No.	*Maximum No.*	*Most common No.*
GCE A level (two year, full time)	3.75	6	5
GCE A level (part time)	2.5	7	3
GCSE (full time)	2	6	4
Intermediate and advanced GNVQ (full time)	9	21	16

Source: inspectorate database

18 More than half of the colleges provide additional teaching in numeracy and information technology for GNVQ students. This varies from half an hour to two hours every week for each skill. Although information technology is often taught as a separate unit, some colleges take the view that separate provision for developing numerical skills is required only in certain vocational areas. Specialist mathematics teachers in one sixth form college provide 15 hours teaching a week, working with vocational course teachers to give extra support to students who are struggling with numerical aspects of their courses.

Management

19 In sixth form colleges, separate departments are usually responsible for each main subject. There is effective leadership of individual subjects, but teachers sometimes work in isolation from colleagues teaching related subjects. In larger colleges, science teachers are often grouped together in a single department with much of their work focused on GCE A/AS level and GCSE courses. Mathematics teachers are based in a number of different departments in some colleges. For example, in one general further education college, those

teaching courses designed for adult students were based in one department while their colleagues, who taught mainly 16 to 19 year-old students, were based in another. A separate computing or information technology department is quite common in large colleges although computing and information technology are often managed alongside business studies. In some general further education colleges, the provision is based in the engineering department or with science and mathematics.

20 Teachers of mathematics, science and computing who work on vocational courses are often active members of the teaching team, an arrangement which helps to ensure that these subjects are taught within an appropriate vocational context. However, such teachers rarely liaise with their counterparts teaching on other vocational courses or on general education courses in order to share good practice or to develop common approaches to teaching. In approximately one-third of colleges inspected in 1996-97, staff teaching GCE A level and GCSE mathematics played little part in developing the teaching of application of number as a key skill in vocational courses.

21 Features of well-managed provision include sound strategic planning and effective arrangements for monitoring and evaluating the quality of courses, strong leadership, clear objectives which are shared by teaching and support staff, roles and responsibilities which are clearly understood, good communications and productive team work. However, there are few colleges in which all these features are present. Weaknesses commonly encountered include:

- a lack of strategic planning
- inadequate management information to support the review and evaluation of courses
- low attendance at meetings leading to poor communications between teachers, support staff and students.

Difficulties in communication and co-ordination are often exacerbated where staff who teach similar subjects are based in different departments or on different college sites.

22 Some general further education colleges fail to ensure a consistent and coherent approach to the planning and delivery of mathematics and science subjects across the college. Rarely do colleges identify one person with a clear brief to co-ordinate the overall development of each subject. The various aspects of each subject are frequently planned by groups of staff working separately in different parts of the college. The lack of co-ordination means that some students are better served than others.

23 A number of colleges have an information and learning technology policy together with a plan to implement it. Some have responded positively to the recommendations contained in the report of the learning and technology committee, chaired by Sir Gordon Higginson. The most comprehensive policies cover all aspects of learning resources and are based on a broad interpretation of information technology. Some policies embrace the development of information technology as a key skill and as a learning aid, and aim to improve the quality of the college's information technology provision. Some far-sighted development plans envisage learning through video-conferencing, the use of multimedia materials and the Internet. The best plans specify clearly the objectives to be met and include performance indicators to help measure progress. A senior manager, assisted by teachers and support staff, has responsibility for implementing the plan and a college-wide policy group advises on priorities, and steers the direction of developments. A user group deals with operational issues. A college-wide approach to information technology facilitates the sharing of good practice, enables resources to be used effectively and helps to ensure that college policy is implemented. Despite prominent examples of effective management, however, there are still many colleges where the co-ordination of information technology across the institution is weak.

A large general further education college has formed a steering group to oversee developments in information technology across the college. The group has produced an information technology policy and strategy for 1996 to 2000 and a response to the learning and technology committee report. Developments are guided by the college's intention to create a 'campus without walls'. The group's ambitious but realistic plans are supported by the college's high-quality computer equipment and extensive information technology support provided for students and staff.

Quality Assurance

24 There are established quality assurance procedures in most colleges which embrace the science, mathematics and computing provision. Course teams are usually required to monitor the quality of their courses against agreed performance indicators. They are required periodically to produce reports which identify the strengths and weaknesses of the provision and specify actions which need to be taken to improve quality. The reports often include a review of examination results, reports by examiners, verifiers and moderators, and the views of students. Some measure the value added to GCE A level results by comparing the GCE A level grades with the grades students achieved at GCSE. Much less common is a similar analysis of the GCSE results.

25 Few colleges have effective arrangements under which employers can contribute to course reviews. In most colleges, course reports vary in quality. Some are rigorous and self-critical; others are insufficiently evaluative. A common weakness is the failure to make systematic use of targets and performance indicators for monitoring the quality of the provision. Some of the questionnaires designed to find out what students think of their courses are too general to provide useful information for reports; for example, they do not require students to comment on the effectiveness of teaching in specific subjects. Action

plans arising out of some course reports are no more than vague statements of intent.

26 Most colleges have yet to develop formal procedures for ensuring that the standards expected of students in numeracy, application of number, and information technology are consistent across all vocational areas. Colleges which have begun to address this issue are usually those with a college-wide strategy for the development of key skills.

> The college's key skills manager, who is a member of the mathematics department, chairs a group of staff drawn from vocational areas. The group decides which aspect of numeracy it wishes to investigate and asks teachers on vocational courses to identify assignments in which the chosen aspect is addressed. The group then establishes whether students on different courses are reaching a comparable standard in that aspect of numeracy. If not, action is proposed to remedy the situation.

> The senior managers of a sixth form college are committed to using information technology in all aspects of teaching and learning and to developing students' information technology skills. The annual information technology development plan draws on an audit of curriculum needs and careful monitoring of the use made of hardware and software. The plan includes a strategy for developing information technology as a key skill on each of the college's courses. It has the support of staff.

27 Teachers attend events organised by examining boards to keep abreast of syllabus developments. Computing teachers work hard to keep their skills up to date in a rapidly developing field. Although a priority in many colleges has been that staff teaching on vocational courses acquire appropriate assessor and verifier awards, progress has been slow in some institutions. Some teachers gain valuable experience

through working as external examiners, moderators or external verifiers. Insufficient emphasis is placed on developing more effective ways of teaching. Even in colleges where staff teaching the same subject are grouped into a department, teaching techniques are rarely discussed. There are few opportunities in most colleges for science, mathematics and computing staff teaching in vocational areas to come together to share ideas and teaching materials.

QUALITY AND STANDARDS

Curriculum Area Inspection Grades

28 Curriculum area inspection grades have improved over the past four years (annexes D and E). In 1993-94, 61 per cent of curriculum areas in computing, mathematics and science were graded 1 or 2. By 1996-97, the figure had risen to 69 per cent, approximately the same as the figure for all programme areas. The percentage of provision graded 1 has varied between 4 per cent and 7 per cent over the four-year period since 1993. The percentage of provision graded 4 or 5 has been between 1 and 3 per cent over the same period.

Teaching and the Promotion of Learning

29 Lesson observation grades in the science programme area have been broadly in line with the average for all programme areas. In 1996-97, strengths outweighed weaknesses in 58 per cent and 57 per cent of mathematics lessons and computing lessons, respectively. The figures for chemistry, biology and physics were 67 per cent, 66 per cent and 61 per cent respectively. The quality of mathematics lessons in sixth form and tertiary colleges tends to be better than in general further education colleges. There are fewer lessons graded 1 in mathematics and computing than in science subjects. The grade profile for GCE A/AS level lessons in mathematics and most science subjects, however, is

significantly better than that for GCSE lessons in the same subjects. GCSE physics lesson grades are higher than those for chemistry or biology; the reverse is true in the case of GCE A/AS lesson grades. The grade profile for lessons in GNVQ and NVQ programmes is significantly lower than that for GCE A level.

30 In general, courses are carefully planned. In a few colleges, teams of teachers work together to ensure that topics are covered in a logical sequence and that learning in one subject can support another. Some schemes of work are detailed and ensure good coverage of the syllabus. The best examples outline the work to be undertaken each week by students, specify assignment dates, give details of practical activities and the way in which key skills are to be developed and assessed. They also provide information on aspects of work such as study visits, work experience placements and student exchange opportunities. In some colleges, course managers scrutinise schemes of work to ensure a consistent approach. Schemes of work in mathematics often lack details of teaching methods to be used and fail to explain to students how their algebraic and information technology skills are to be developed. The majority of lessons across the programme area are well planned and learning objectives are shared with students.

31 Often, students have a good rapport with teachers which helps to build their confidence and develop their enthusiasm for the subject. Effective teachers use varied methods of working to maintain the interest of their students. In the best theory lessons, they explain key principles clearly and make sure that students understand the topic through the skilful use of questions and discussion. Many teachers make good use of the students' and their own experience to reinforce learning. In some lessons, students are given copies of the overhead transparencies used by the teacher with space for their own notes, so saving time spent taking notes. Some teachers also make effective use of other teaching aids such as video tapes. Computing teachers in over three-quarters of colleges inspected in 1996-97 provided students with

carefully thought-out, paper-based instructional materials. Some teachers use large screen displays to demonstrate the main features of computer software applications but few of them make extensive use of facilities such as electronic mail or CD-ROM databases. Teachers often require students to work in teams. Case studies are used frequently, although less so in mathematics, to test students' ability to apply theory to practical problems.

> Students in a GCSE mathematics class were asked to describe mathematically the number of different ways they could pair teams who had entered for a sports tournament. The students worked in groups to devise formulae and to test out their hypotheses. The teacher's skilful use of whole-class presentation and discussion created a lively and stimulating atmosphere and all students participated in the work.

> In a GCE A level computing lesson, students were introduced to the principles of computer control systems in the context of a system in use at Kew Gardens. Frequent questioning by the teacher elicited responses from the students which were based on their own experiences and knowledge. This led to a lively discussion in which all were involved. The teacher then moved on to consider a control system for a nuclear power station and the students were able to apply the knowledge they had gained earlier to this new situation.

32 Despite much good teaching, a substantial proportion of lessons have significant weaknesses, including:

- teachers talking for too long a period and students losing interest
- students spending an excessive amount of lesson time copying out notes prepared by the teacher

- a failure to involve students sufficiently in discussions
- a lack of attention paid to the different learning needs of students in the same class.

Many mathematics teachers employ a narrow range of teaching methods. Some GCSE mathematics and science lessons are particularly uninspiring and fail to motivate students. There is a tendency for students to repeat work which they find easy rather than concentrating their efforts on difficult topics or topics which they have not studied before. In most colleges, mathematics teachers do not place enough emphasis on developing students' numerical and algebraic skills and there is not enough use of information technology as a way of investigating mathematical relationships. Less than 20 per cent of colleges inspected in 1996-97 used computers to promote learning in mathematics. The failure by some teachers to recognise that students have different levels of knowledge and expertise is more pronounced in theory lessons than in practical sessions.

33 Colleges are developing learning resource centres where students can study on their own using information technology and other learning materials. Mathematics students using the centres usually have their own programmes of study which they can follow at a pace which suits them, calling on specialist tutors when necessary. Adult students often enjoy working through their programmes in this way but some younger students who are required to work in the learning centres for long periods do not find the experience stimulating. The use of learning centres in science is underdeveloped.

34 The inspection grades awarded to practical lessons tend to be higher than those awarded to theory sessions. Practical work in computing, information technology and science is usually combined well with theory, so that learning in one aspect reinforces learning in the other. Students in well over 75 per cent of colleges inspected in 1996-97 worked on well-designed, realistic practical assignments which

were preparing them well for employment and higher education. In a few colleges, students complete projects for local companies or community organisations. In practical lessons, the tasks are broken down into manageable stages and, generally, students are allowed to progress at a pace which suits them, within the constraints of the course. Sufficient help is available from teachers and technicians in most lessons. Teachers are skilled at providing support. Occasionally, students are left for too long without receiving the help they need.

> To establish the desirable properties of containers used to store medicines, students aiming for a national certificate in pharmaceutical science were asked to carry out tests on various materials. This activity enabled them to identify the key principles involved in storing medicines. In the discussion which followed, the teacher noted the essential points on the board and drew on this information to develop relevant theory and extend the students' understanding of it.

> Students in a well-organised BTEC national diploma computer studies lesson were working in small groups to build a computer to a given specification. Each group had a kit of components and a carefully prepared prompt sheet. The teacher used the lesson to check students' understanding of the way a computer operates and the function of some of its components. The students were enthusiastic about the assignment and eager to complete the work.

35 On some GCE and GCSE courses, teachers do not allocate enough time to allow students to carry out meaningful practical work. In a few colleges, mathematics students undertake practical work which reinforces their understanding of mathematical concepts. Most mathematics students, however, have inadequate opportunities to tackle practical problems or experience issues encountered by mathematicians in industry and commerce.

Groups of GCE A level mathematics students were invited to spend a week working with staff from a car manufacturer. The students were asked to solve a problem experienced by the company and to present their findings to senior managers at the end of the week. This enabled them to use their mathematical knowledge and a wide range of analytical and interpersonal skills to arrive at solutions that best met the company's requirements.

36 Most colleges provide work experience placements for students on vocational courses. Appropriate placements allow students to set their learning in context and to gain insights into industrial practices. However, work experience is not always integrated well with other aspects of courses, and some students have difficulty relating their work to their studies. Finding appropriate work experience providers is proving difficult in areas of the country, such as London, where a large number of sector colleges are concentrated. It is unusual to find work experience as a compulsory component of general education courses. Here, work experience is more often offered on a voluntary basis and the take-up by students is low. Only 30 per cent of GCE A level science students had a work placement in 1996-97.

37 The quality of mathematics teaching on vocational courses varies. In the best lessons, teachers make sure that students acquire essential mathematical knowledge and skills and work closely with their colleagues to ensure that mathematics assignments are relevant and realistic. On some GNVQ courses and other vocational programmes, teachers succeed in integrating mathematics and numeracy with the vocational elements of the course. However, separate lessons often fail to meet students' needs. Many lack a clear sense of purpose, are uninspiring and provide little incentive for students to improve the numerical and mathematical skills they already possess.

An assignment for students taking a course leading to a higher national certificate in automobile engineering focused on testing the performance of cars. The students applied their mathematical knowledge and skills to a series of tasks which enabled them to determine how the design of a car could be altered to improve its performance. The students worked on the assignment during a lesson so that they could ask for help and discuss key issues with each other. They were enthusiastic about the task and worked confidently, applying their knowledge of calculus, vectors and dynamics and using information technology as a mathematical tool.

In the first term of their course, advanced GNVQ health and social care students spent 1.5 hours a week working on mathematical assignments. For one assignment the students investigated levels of deprivation and health in various wards of their city. The analysis of data on unemployment, hospital admissions and death rates provided considerable scope for students to apply their numerical skills in a relevant context.

38 Many vocational courses contain specialist information technology modules. These are often well taught by computing staff who make every effort to relate the learning materials to the vocational specialism of the students. However, the extent to which the teachers of vocational modules make effective use of information technology in their teaching varies.

In one general further education college, teachers made a determined effort to ensure that students developed information technology skills relevant to their main area of study. Students on courses leading to NVQs in hairdressing used spreadsheets to assist them in a stocktaking exercise; BTEC national diploma sports studies students used medical diagnostic equipment with computer software to analyse the overall fitness of people taking exercise; GNVQ art and design students made effective use of graphics packages to produce items such as posters and invitations to events.

39 In around 50 per cent of colleges inspected in 1996-97, teachers' expectations of the amount of work students should undertake outside formal lessons was not made sufficiently clear to students. In the best practice, colleges have a defined homework and marking policy to which all teachers adhere. Students are expected to submit work regularly and complete assignments within clearly specified timescales. Where colleges have not been as explicit in their expectations, students are often not as conscientious as they should be in completing tasks. Some teachers do not expect students to undertake much work over and above what is covered in lessons.

40 The quality of teachers' marking varies widely. Solutions to problems and assignments are often carefully marked; students are told where mistakes have been made and where improvements are possible. Sometimes, teachers provide students with model solutions to save writing corrections on the students' written work itself. Nevertheless, students who struggle with their work are not always given enough guidance on how to improve. Most colleges which have adopted modular syllabuses monitor students' progress and achievements rigorously. On GNVQ and vocational courses, the completion of assessed coursework is recorded carefully and students' portfolios are reviewed regularly. Sometimes, students' numeracy skills are assessed too infrequently to enable appropriate corrective action to be taken.

Support for Students

41 Colleges provide a range of services for students who need additional support to help them to learn. Most students are assessed when they enrol to determine their levels of numeracy and literacy. However, few colleges assess students' information technology skills on entry. Specialist mathematics teachers often have little involvement in designing numeracy tests, scrutinising the results, or deciding on the level or type of support students require. There are often substantial delays in matching support to students' needs and many of the students who require additional support have a poor record of attendance at support sessions. In many cases, teachers who provide additional support do not work sufficiently closely with the main subject teachers to ensure that the support provided is appropriate. Colleges need to evaluate more thoroughly the effectiveness of the support they provide for students with weaknesses in numeracy.

42 Students on specialist mathematics and science courses are often given the chance to attend remedial sessions if they are struggling with particular topics. Approximately 70 per cent of colleges inspected in 1996-97 offered such support sessions in mathematics. The figure was lower in science; just below 50 per cent. Sixth form colleges and tertiary colleges offer this type of support more commonly than do general further education colleges. In some colleges, staff strongly advise students who do not reach satisfactory standards in assignments or who strive for high grades in external examinations to attend extra classes. Although these sessions are often open to all science and mathematics students, in practice, they are only used extensively by GCE A level and GCSE students.

At a sixth form college, biology teachers organise lunchtime revision sessions to prepare students for module tests. The sessions are attended voluntarily and students are informed of their content in advance and encouraged to attend. The topics cover key areas expected to feature in forthcoming tests and focus on the more difficult concepts. The sessions are greatly valued by students.

43 Many colleges provide workshops in mathematics, numeracy, information technology and, increasingly, science. Students can use the workshops to reinforce their understanding of particular aspects of their course or to work on assignments. Assistance is available from staff on duty in the workshops. Students on vocational courses are particularly encouraged to attend workshops regularly. In contrast to science workshops, mathematics, numeracy and information technology workshops are well attended.

Students at a large general further education college receive individual help from a teacher in the science learning resource centre where they are able to undertake additional practical work. On average, about 30 students use the facility each day, which is also available in the evening.

A tertiary college offers mathematics and numeracy support to students. Each week, a mathematics workshop is open for three, two-hour sessions to support GCE A level and GCSE mathematics students. For students who have difficulty passing the tests in mathematics, included in some courses, the college offers additional lessons on Monday evenings. All these services are provided by specialist mathematics teachers. Students from other courses who struggle with numeracy or other aspects of mathematics are referred to a numeracy workshop so that basic skills staff can diagnose their weaknesses and devise programmes of work to meet their needs.

44 Some colleges do not have adequate records of those who attend support classes and learning workshops. Where information is recorded, it is rarely analysed to find out if there are underlying weaknesses in the design of courses which result in particular groups of students seeking support.

Students' Achievements

45 High levels of attendance and punctuality commonly result from effective registration systems and procedures to investigate persistent lateness and absenteeism. Many colleges have policies on absenteeism and punctuality which lack clarity or are not enforced rigorously. Some colleges have effective systems for monitoring attendance but do not have adequate arrangements to identify students who withdraw early from courses. In 1996-97, the average level of attendance at mathematics, computing and science lessons observed by inspectors was 77 per cent, which is the same as the average for all lessons observed. Attendance levels were highest in GCE A/AS level classes, at 83 per cent. However, the average level of attendance in GCSE sessions was only 68 per cent. In a few colleges inspected, the average attendance in the lessons observed was below 60 per cent. In some

cases, students who are late for lessons were not challenged by the teacher. Students on part-time vocational courses generally have good records of punctuality and attendance.

46 Students on advanced level courses are usually well motivated, enjoy their studies and establish positive relationships with teachers and other students. Most of them work hard in lessons and want to succeed. Adult students work particularly conscientiously. Some students thrive on the demands of GCE A/AS level courses and enjoy the challenge of solving interesting, challenging problems. Others find the work more difficult than they expected and lack confidence in their ability to apply what they have learned to problems which appear unfamiliar. Students studying lower level qualifications tend to be less well motivated, require imaginative teaching to maintain their interest and need considerable additional support.

47 Many science, computing and mathematics students have weak numerical and algebraic skills. At GCSE level, for example, they cannot manipulate algebraic expressions or solve equations with confidence. They are too dependent on calculators to carry out the simplest of calculations. Many cannot simplify straightforward fractions for themselves and end up working with recurring decimals instead. Poor recall of multiplication tables prevents some from carrying out mental arithmetic correctly. Students on vocational courses often have similarly underdeveloped numeracy skills. Science and mathematics students, generally, have relatively limited appreciation of how information technology can be used to analyse problems in these subjects.

48 GCE A/AS level mathematics students often achieve high standards of work. Many can apply mathematical principles and techniques appropriately and present clear, logical solutions to a wide range of problems. Some enjoy tackling unusual questions which do not call for routine responses but rely on more sophisticated problem-solving skills. Solutions are usually well presented and logically argued. However,

some students find aspects of GCE A level work difficult and fail to grasp essential theoretical points. When solving problems, some students slavishly apply techniques, used earlier by their teachers to solve broadly similar problems, without a proper understanding of the key principles underlying them.

49 Full-time GCE A/AS level science students are interested in their studies and many produce good quality work which demonstrates a comprehensive understanding of theoretical concepts. The best students prepare thoroughly for their lessons and make good use of background reading in class discussions. Science students respond well to the practice examination questions which they are often required to do. The students usually carry out practical work safely and competently although many of their written records of experiments contain insufficient detail. The standard of work produced by part-time GCE A/AS level students is generally not as high as that produced by full-time students.

50 GCE A level results in 1997 by subject and type of sector college are shown in table 2. In some colleges, pass rates are low. Better results are achieved by students attending sixth form colleges than other sector colleges. Staff in general further education colleges claim that GCE A/AS level students are usually less well qualified than their counterparts in sixth form colleges. However, few general further education colleges rigorously analyse the achievements of their students in relation to their entry qualifications in order to estimate the value added by the college. Pass rates in computing and human biology tend to be lower than in other subjects.

Table 2. GCE A level results, 1997

Subject	*Sixth form colleges*		*Other colleges*	
	Grade		*Grade*	
	A to C %	*A to E %*	*A to C %*	*A to E %*
Mathematics	61	90	42	71
Computer studies	43	80	31	63
Biology	56	89	40	77
Human biology	38	79	28	59
Chemistry	60	89	41	71
Physics	60	89	44	76

Source: inspectors' statistical handbook, version 5

51 The number of students who take GCE AS subjects is small; about 8 per cent of total GCE A/AS level enrolments in mathematics, computing and science subjects. GCE AS mathematics has the largest number of students with over 1,000 in sixth form colleges and approximately the same number in general further education and tertiary colleges. In all subjects within the science programme area, pass rates are lower than for the corresponding GCE A level subjects. The results by subject and broad type of college are shown in table 3.

Table 3. GCE AS results, 1997

Subject	*Sixth form colleges*		*Other colleges*	
	Grade		*Grade*	
	A to C %	*A to E %*	*A to C %*	*A to E %*
Mathematics	16	56	13	40
Computer studies	28	73	18	57
Biology	19	61	13	51
Human biology	21	59	11	43
Chemistry	15	53	11	39
Physics	26	64	14	41

Source: inspectors' statistical handbook, version 5

52 The extent to which GCSE students cope with the demands of their course varies considerably. Adult mathematics students often reach higher standards in numeracy and statistics than students aged 16 to 19 but have more difficulty with algebra, trigonometry and geometry. Students resitting GCSE mathematics sometimes do not fully understand the problems they are asked to solve. Some mathematics students arrive at the right answer without providing sufficient explanatory working or without understanding the stages of their arguments. GCSE science students, particularly those aged between 16 and 19 often lack motivation. The best GCSE work is often produced by adult students studying part time.

53 Sixth form college students perform better in GCSE subjects than students from other types of colleges (table 4) and GCSE grades achieved in sector colleges are lower than those in schools. Adult students consistently achieve better results than those aged between 16 and 18 years of age. When completion rates are taken into account, results on GCSE courses are often particularly poor. In many cases, less than 20 per cent of students enrolling on GCSE courses in mathematics, science and computer studies obtain grades A* to C.

Table 4. GCSE results, 1997

	Sixth form colleges	*Other colleges*	
GCSE subject	***Students all ages A* to C %***	***Students aged 16 to 18 A* to C %***	***Students aged 19 and over A* to C %***
Mathematics	43	30	48
Computer studies	64	29	61
Biology	35	32	52
Human biology	37	23	54
Chemistry	50	38	63
Physics	43	34	54

Source: inspectors' statistical handbook, version 5

54 Computing and information technology students are particularly enthusiastic about the practical aspects of their course. Most are competent in their use of computer hardware and software and take a pride in their work. They display sound theoretical knowledge of theory which they can apply to practical problems. Many students develop professional levels of expertise by working on realistic assignments with industry-standard equipment and software. Most GNVQ students become competent in a good range of computer applications but their programming skills are not always well developed. BTEC national diploma computer studies students often have good programming skills and a sound understanding of the principles of systems analysis and design. Students on computing and information technology vocational courses make good progress in developing presentational and teamwork skills. This prepares them well for higher education and for working in project teams in industry and commerce.

55 Students on full-time vocational science courses generally respond well to the demands which are placed on them, although some are not highly motivated and find it difficult to maintain the level and pace of work required of them. Students' project work is often well researched and presented. The quality of work produced by students on part-time programmes depends on the extent to which they can draw on their current work experience. If their job is closely related to their area of study, they often produce high-quality work.

56 Pass rates are variable on courses leading to vocational qualifications. Less than half the students tested on courses leading to GNVQ qualifications in 1996 had gained the full award by October 1996. Table 5 gives details of GNVQ pass rates for 1996. Students taking science courses at intermediate level were the most successful.

Table 5. GNVQ pass rates, 1996

Course	*Full award %*	*Partial award %*
Foundation GNVQ in information technology	35	22
Foundation GNVQ in science	31	25
Intermediate GNVQ in information technology	37	21
Intermediate GNVQ in science	51	32
Advanced GNVQ in information technology	31	57
Advanced GNVQ in science	42	52

Source: inspectors' statistical handbook, version 4

57 In 1996, 88 per cent of students tested obtained full or partial awards in information technology at advanced level, higher than the figures of 58 per cent at intermediate level and 57 per cent at foundation level. There was a similar situation in GNVQ science where 94 per cent of advanced level students tested obtained full or partial awards

compared with 83 per cent of intermediate level students and 56 per cent of foundation level students. BTEC national diplomas in computer studies, information technology applications and in science provide many students with an alternative route into higher education and employment. Pass rates are generally good amongst those who complete their course; often around 80 per cent. Many part-time students who wish to improve specific computing skills take C&G modules. Pass rates for these courses and for units on NVQ programmes are generally good.

Retention

58 Retention rates for courses are often low, especially in some general further education colleges. Low rates mean that many students who enrol on courses fail to gain the full award. Instances of low retention are found across the full range of courses in the programme area; full-time GCSE and part-time evening courses are particularly affected. Retention rates for a range of vocational courses in a sample of 30 colleges inspected in 1996-97 are shown in table 6.

Table 6. Retention rates on vocational courses, 1996

Course	***Retention rate %***
Intermediate GNVQ in science	79
Intermediate GNVQ in information technology	71
BTEC national diploma in science	71
BTEC national diploma in computing/ information technology	64

Source: inspectorate database

Destinations and Progression

59 Progression rates from GCE A/AS level courses in sixth form colleges and tertiary colleges to higher education are high. Access to higher education courses generally meet their primary objective in enabling students to enrol on degree and higher diploma courses. Vocational courses in specialist science subjects generally enhance students' prospects for progression and promotion within the relevant industry. Although progression to higher education is monitored, particularly by sixth form colleges, few colleges systematically analyse students' destinations in order to improve the relevance of courses or to provide other students with better guidance on whether particular courses match students' career aspirations.

RESOURCES

Staffing

60 Teachers of computing, information technology, mathematics and science are, generally, committed to their work and well qualified in the subjects they teach. Most have relevant first degrees or equivalent professional qualifications. A significant number of information technology teachers were employed originally in other subject areas and have retrained. Some have limited formal computing qualifications. Teachers usually have teaching qualifications and considerable classroom experience. Although some specialist mathematics and science teachers have well-developed information technology skills, there are many who have little awareness of the capability of computers as teaching aids. Where there is only one teacher in each of the science subjects on offer, the scope for developing the subject is limited. Although some teachers on computing and information technology, and specialist science courses have recent, relevant industrial experience, many full-time science and computing teachers lack such experience.

In one large general further education college, the teacher on an environmental health course is a member of the Chartered Institute of Environmental Health, an examiner on similar courses in other colleges and has had recent experience of working as an environmental health officer.

61 In general further education colleges, there is a heavy dependence on part-time teachers. Most are appropriately qualified. Their industrial experience is often more recent than that of full-time teachers and they can bring a fresh dimension to their subject. However, many part-time teachers work in isolation from their full-time colleagues. Some have too much freedom to decide which syllabuses to adopt, the structure of their courses and the frequency with which students are assessed. As a result, students aiming for the same qualification but taught by different teachers can have widely differing learning experiences.

62 Colleges have well-qualified and highly valued technical support staff teams who service information technology and science programmes. They provide technical support for practical activities and often order equipment and consumables, and carry out health and safety checks. Their role has changed in recent years and many now act as instructors or trainers. In large, multi-site colleges there is sometimes an imbalance in the technical support across sites. Where there are insufficient technicians to service equipment, faults are not repaired quickly enough or the equipment does not function efficiently.

Equipment and Learning Resources

63 In the best colleges, computing and information technology students have access to a good selection of specialist text books, reference books, CD-ROMs, and video and audio tapes. They can also make use of the Internet and modern, multimedia workstations which are often available in colleges' learning centres. In most sixth form

colleges, a wide range of textbooks and other learning materials are readily accessible to mathematics students in their classrooms. However, in many general further education and tertiary colleges, students rely heavily on worksheets and printed notes provided by the teachers because other resources are unavailable. Many colleges have comparatively few mathematics or science library books and, in some cases, the stock is out of date.

> At a small sixth form college, high-quality support packs are being developed for all GCE A level modular courses. These contain worked examples of problems and examination questions, graded exercises which are all cross-referenced to a wide range of text books. Their use in the learning resource centre is monitored.

64 Some colleges have equipment which, together with help from staff, provides effective support for students with disabilities. Examples of such equipment include facilities to allow students with a visual impairment to handle computer files using Braille, induction loops for students with a hearing impairment, and computer workstations which can easily accommodate students who use a wheelchair.

65 Colleges have invested heavily in information technology equipment, which is often of a similar standard to that used in commerce and industry. Workstations are frequently on a college-wide network giving students access to standard software at a number of locations. These arrangements also provide ready access to peripheral equipment such as high-speed printers, scanners and modems. Increasingly, information technology learning centres are open to students and to the local community in the evenings, at weekends and during college vacations. In some colleges, laptop computers can be borrowed by students. However, few colleges adequately monitor the use students make of such facilities in order to plan future developments. Despite the substantial progress made by colleges, many

students still do not have adequate access to modern computing equipment outside timetabled lessons. Access to equipment is sometimes restricted by the delivery of theory lessons in specialist computing rooms. Some computing students are required to use obsolete software and unreliable computing equipment. Science and mathematics students in the vast majority of colleges have insufficient specialist software. Science laboratories frequently lack dedicated computing equipment or have only old machines. In most classrooms where mathematics is taught, staff and students do not have easy access to computers.

> A sixth form college has computer workstations in well-equipped learning centres, classrooms, laboratories and workshops. All the workstations are connected to a college-wide network with general and subject specific software available through a simple menu system. Students and teachers make effective use of these facilities.

66 Colleges which provide science courses have sufficient scientific equipment. Colleges involved in highly specialised work have good links with companies or universities which sometimes purchase or donate specialist equipment. For example, a college that runs specialist courses in pharmaceutical science, mainly to meet the needs of a local pharmaceutical company, has had a substantial amount of equipment donated by the company. This has improved the practical work of many students, not just those on the specialist courses. General science equipment is serviceable but often old and most colleges do not have a replacement policy to ensure that equipment is kept up to date.

Accommodation

67 Much of the accommodation used for computing and information technology is of high quality, having been refurbished to meet commercial standards. There are pleasant, well-designed, open-plan

workshops, which often have facilities for the control of temperature, lighting and ventilation and which are made more attractive by the use of plants and wall displays. The computing rooms in some colleges contain too many machines. Conditions are cramped. Students do not have enough space to prepare written work or to work in teams and teachers are unable to circulate easily amongst the students.

68 Most mathematics classrooms are fit for the purposes for which they are used. Many sixth form colleges have areas designated exclusively for mathematics which help to create a focus for the subject and enable staff and students to make best use of the resources. In larger colleges, many classes are timetabled to take place in general teaching rooms scattered around the campus. Such rooms provide a less stimulating environment and there is often a lack of storage space.

> The mathematics teaching in a sixth form college takes place in eight dedicated classrooms which, together with a storeroom and staff workroom, are grouped around a central resource area. The resource area, which students can use for private study, is well furnished and equipped with textbooks, worksheets and computers. The mathematics accommodation benefits from displays of students' work, information about higher education courses and the role of mathematics in particular jobs.

69 There are many examples of carefully designed, purpose-built science laboratories. The best accommodation often has a suite of laboratories grouped around a central staff work room. This helps to create a good team spirit amongst staff and a stimulating environment for students. However, the laboratories in many colleges are old and fixed benches limit the range of uses to which the accommodation can be put. Where there is a lack of general classrooms, laboratories sometimes provide unsuitable accommodation for the teaching of theory. The use of space in laboratories is often poor. Many colleges have limited storage facilities for science equipment and cramped staff rooms.

At a medium-size general further education college, there are six laboratories and an associated preparation room. They are just over a year old, have been carefully designed, and are furnished to high standards. New staff accommodation, built to the same high standard is located next to the laboratories. The staff room has windows arranged so that teachers sitting at their desks can see what is happening in the laboratories.

ENROLMENTS BY SUBPROGRAMME AREA, 1995-96

Subject	*Enrolments*
Physics	22,000
Chemistry	30,000
Biology	51,000
Other sciences	158,000
Mathematics	132,000
Computing/information technology	252,000
All programme areas	721,000

Source: individualised student record, July 1996

SUBPROGRAMME AREAS

anatomy and physiology
astronomy
audiology
biochemistry
biology (including social biology)
botany
chemistry
clinical dentistry
clinical medicine
combined or general science
computing (including computer science, computer studies, computer programming)
environmental science
food science
genetics
geology
information science
information technology
materials science
mathematics
medical subjects (including environmental health, cleaning science)
microbiology
molecular biology and biophysics
nutrition
operational research
opthalmics
pharmacology
pharmacy
physical science (including meteorology, earth sciences)
physics
sports studies/science
statistics
veterinary sciences
zoology

LESSON OBSERVATION GRADES, 1996-97

Table 1. Overall grades, 1993 to 1997

Year	***1*** ***%***	***2*** ***%***	***3*** ***%***	***4*** ***%***	***5*** ***%***
1993-94	14	45	34	6	1
1994-95	13	48	32	7	<1
1995-96	16	46	32	6	0
1996-97	16	43	32	8	1
1993 to 1997	15	46	32	6	1

Source: inspectorate database

Grade descriptors

Grade 1 *Provision which has many strengths and very few weaknesses*

Grade 2 *Provision in which the strengths clearly outweigh the weaknesses*

Grade 3 *Provision with a balance of strengths and weaknesses*

Grade 4 *Provision in which the weaknesses clearly outweigh the strengths*

Grade 5 *Provision which has many weaknesses and very few strengths.*

Table 2. Grades by course type, 1996-97

Course	***1 %***	***2 %***	***3 %***	***4 %***	***5 %***
GCE A/AS level	20	44	31	5	0
GCSE	12	42	38	8	0
GNVQ	13	40	31	15	1
NVQ	12	46	30	11	1
Access to higher education	23	45	29	2	1
Basic education	16	44	28	12	0
Other vocational	15	41	34	9	1

Source: inspectorate database

Table 3. Grades by subprogramme area, 1996-97

Subprogramme area	***1 %***	***2 %***	***3 %***	***4 %***	***5 %***
Mathematics	14	44	35	6	1
Computing	12	45	33	7	3
Chemistry	23	44	24	9	0
Biology	24	42	30	4	0
Physics	23	38	33	6	0
All subprogramme areas	**16**	**43**	**32**	**8**	**1**

Source: inspectorate database

CURRICULUM AREA GRADES, 1993 TO 1997

Year	***1*** ***%***	***2*** ***%***	***3*** ***%***	***4*** ***%***	***5*** ***%***
1993-94	7	54	37	2	0
1994-95	4	62	31	3	0
1995-96	6	62	31	1	0
1996-97	7	62	29	2	0

Source: inspectorate database

GRADE COMPARISONS ACROSS PROGRAMME AREAS, 1993 TO 1997

	% grades 1 and 2				% grades 4 and 5			
	Lessons		Curriculum areas		Lessons		Curriculum areas	
Year	Science	All	Science	All	Science	All	Science	All
1993-94	59	58	61	65	7	8	2	2
1994-95	61	63	66	71	7	8	3	3
1995-96	62	63	68	68	6	7	1	2
1996-97	59	61	69	68	9	8	2	2

Source: inspectorate database

BIBLIOGRAPHY

Review of Qualifications for 16–19 Year Olds, Sir Ron Dearing, School Curriculum and Assessment Authority, London, 1996

GCE Advanced Supplementary and Advanced Level Examinations 1996, Ofsted, London, 1996

Report of the Learning Technology Committee, Chaired by Sir Gordon Higginson, FEFC, Coventry, 1996

Joint Report of the Royal Society and the Joint Mathematical Council of the United Kingdom: Teach and learning algebra pre-19, Royal Society, Joint Mathematical Council of the United Kingdom, London, 1997

Candidates' Performances in Public Examinations in Mathematics and Science 3, CT Fitz-Gibbon and L Vincent. A report commissioned by School Curriculum and Assessment Authority from the Curriculum, Evaluation and Management Centre, University of Newcastle upon Tyne, 1994

Review of 100 NVQs and SVQs, A report submitted to the Department for Education and Employment by Sir Gordon Beaumont, Evaluation Advisory Group, Chesterfield, 1996

Published by the
Further Education
Funding Council

March 1998

Cheylesmore House
Quinton Road
Coventry CV1 2WT