A subject-based aspect report on provision in Scotland's colleges by HM Inspectors on behalf of the Scottish Funding Council

Life sciences
10 September 2010

Scottish Funding Council
Promoting further and higher education

HMIe
improving Scottish education
leasachadh foghlam na h-Alba

Contents

1 Introduction and methodology

Introduction

The HM Inspectorate of Education (HMIE) publication, *External quality arrangements for Scotland's colleges, September 2008*, specifies that HMIE will produce a number of subject aspect reports over the four years 2008-2012. These reports complement in a subject-specific context the generic evaluations of learning and teaching in HMIE's reports of colleges. Colleges should act on the recommendations contained in these reports. College inspectors will monitor action towards implementation of these recommendations as part of their normal dialogue with colleges, and will wish to discuss issues arising from subject aspect reports during annual engagement visits.

In preparing this report, inspectors visited a sample of eight colleges, drew on the findings of published HMIE reviews of colleges, and examined other relevant publications and reports. They consulted with key stakeholders, including employers and professional bodies.

This report evaluates college programmes within the life sciences curriculum area. Programmes covered by this report are offered at levels 4 to 8 of the Scottish Credit and Qualifications Framework (SCQF). These programmes provide education and training for an industry sector that is making an increasingly important contribution to Scotland's economy.

Methodology

Each college in the sample of eight was visited twice during the fieldwork. Inspectors evaluated the quality of provision through observations of learning and teaching, and discussions with learners, teaching staff and curriculum managers. They also had discussions with local employers and other stakeholders. Colleges gave inspectors access to a range of curriculum documentation, including learning and teaching material, planning and self-evaluation reports. In a number of colleges, areas for development identified by inspectors during the first visit had been addressed by curriculum managers and teaching staff by the time of the second visit. A list of colleges visited during the fieldwork for this report may be found in Appendix 1.

This aspect report evaluates current practice, and identifies important areas for discussion and further development amongst practitioners. It identifies excellent practice found by HM Inspectors and sets out recommendations for improvement.

2 Summary of key findings

Life sciences provision in Scotland's colleges is characterised by many strengths:

- Around a quarter of Scotland's 43 colleges offer a significant range of life sciences programmes which allow learners to gain skills and knowledge to support employment or further study in the life sciences area. These typically include a suitable suite of introductory level further education (FE) programmes, advanced level higher education (HE) provision, and work-based vocational qualifications.

- Of these colleges, most offer a valuable range of provision for local primary and secondary schools, supporting strong school/college partnership working. This provision articulates well with the principles of *Curriculum for Excellence*, making science accessible and enjoyable and to encourage young people to consider future careers in science areas.

- Almost all learners are well motivated and conscientious, using a range of resources well to support learning. They develop useful practical skills, observing high levels of laboratory safety awareness, which prepare them well for future employment or further study. Most learners display good knowledge and understanding of subject matter, working well on their own or in small groups.

- Teaching staff use their subject and professional knowledge well to engage learners and relate classroom and laboratory activities to industry practice. They strike an appropriate balance between teacher-led activities and opportunities for learners to be actively engaged in practical work, working in groups or independently on relevant tasks. They use practical work well to develop learners' skills for employability and further study.

- The majority of colleges have invested significantly in laboratories that are fit-for-purpose, reflecting industry standards and providing a realistic working environment for the vocational science programmes on offer.

- All colleges provide potential learners with clear information about science programmes on offer through their websites, including information about programme content, entry requirements and the opportunities for progression to further study or employment. College websites also contain helpful information about the range of support available to learners, including financial support. Most learners receive helpful guidance and support throughout their time in college.

- Most teaching staff use a range of ongoing assessment approaches well to check learners' understanding of learning. All colleges have very well-established systems to organise and manage final assessment for certification.

- Most learners gain useful employability skills through the development of practical skills during laboratory work and working with other team members. Most learners also gain useful citizenship skills which are often developed during planned project work where issues of local, national and international interest can be explored and discussed.

- Most learners who successfully complete life sciences programmes progress to further study or employment. Most colleges have very good articulation arrangements with local universities and a few have very good *2+2* arrangements where learners with a Higher National Diploma (HND) can progress directly to the third year of an honours degree programme.

- All science programme teams are committed to improving the quality of the learner experience and the use of self-evaluation and internal review as tools for enhancement and improvement. Overall, the views of learners are well represented and taken account of in the evaluation of learning and teaching.

However, there are a number of areas for development which needs to be addressed to improve the overall experience for learners:

- In some theory lessons, teaching staff use too limited a range of teaching approaches and do not promote active learning, resulting in learners not being fully engaged. In these classes, staff do not involve learners sufficiently in asking and answering questions, working cooperatively in groups or using information and communications technology (ICT) to find answers to questions and solve problems.

- Learners are not involved significantly by teaching staff in the planning of learning activities and approaches.

- In some colleges, facilities for carrying out practical work in science are in need of refurbishment in order to create a suitable learning environment consistent with modern industry standards.

- Success levels for learners on full-time science programmes are low with around 75% of learners who complete programmes gaining a qualification.

- Most programme teams do not analyse rigorously enough learner data where low retention or attainment exists, nor fully explore possible underlying reasons for low performance.

3 Background and context

Science is vital for Scotland's future. It is a keystone in delivering the Government's purpose of creating a more successful Scotland with opportunities for all to flourish through increasing sustainable growth.

These words introduce the Scottish Government's document *Science for Scotland*[1] (2008) and emphasise the importance of the science, engineering and technology (SET) sectors in the Scottish economy. Scotland has a long tradition of excellence in science and past economic successes have drawn heavily on our abilities in SET. Science is essential for sustainable business growth in Scotland in the key sectors that underpin our economy. Often, this is where existing businesses use science to solve their problems, develop new products and increase competitiveness. Successive Scottish Governments have highlighted this commitment to further developing scientific skills and approaches.

More generally, the Scottish Government's skills strategy, *Skills for Scotland*[2] (2007), highlights Scotland's long tradition of valuing learning for the wider benefits it can bring to the individual, to society and communities and to the economy. In particular, higher level skills, such as creativity, innovation and entrepreneurship are viewed as vital in order that industries in which Scotland operates at the leading edge, such as life sciences, can continue to compete favourably. *Curriculum for Excellence* is encouraging schools to provide pupils with increased opportunities to build work-related knowledge, experience and skills through an expansion in school/college partnerships.

In 2007, the Sector Skills Council for Science, Engineering and Manufacturing Technologies (SEMTA) carried out a major investigation into skills needs and skills gaps in the Bioscience sector across the United Kingdom (UK), including Scotland[3]. Skills gaps in the current workforce were identified in a range of both scientific and generic skills. The main scientific skills gaps included:

- bioscience and molecular biology;
- analytical and physical chemistry;
- biochemistry; and
- biotechnology/biopharmaceuticals.

The main generic skills gaps were in:

- business skills;
- management skills;
- information technology (IT) skills (general);

[1] http://www.scotland.gov.uk/Publications/2008/11/24143207/0
[2] http://www.scotland.gov.uk/Publications/2007/09/06091114/0
[3] http://www.semta.org.uk/employers/science/about_sector_skills_agreements/bioscience_ssa.aspx

- project management;
- team working; and
- regulation.

Fifty-one percent of the 39 Scottish bioscience companies in the SEMTA survey indicated skills gaps in their current workforce. The range of occupations included science managers, senior scientists, senior researchers, laboratory technicians and science-related IT. Employers indicated that when they are recruiting, generally at graduate level, they are looking primarily for a depth of scientific knowledge and skills in biological science, chemistry and mathematics. They are also looking for interdisciplinary awareness, practical skills, experience in industry, the ability to work to regulatory standards and communication skills.

Clearly, high quality science education is central to delivering the science workforce for the future. In *Science for Scotland* the Scottish Government commits to:

- *encouraging more young people to prepare for, and pursue science careers;*
- *making science in schools and colleges more challenging, relevant, interesting and exciting; and*
- *improving the match between science course provision and demand.*

Scottish Government argues that achieving the vision of *Science for Scotland* depends on actions by all of the individuals and organisations that make up the science base in Scotland, in the public, private and voluntary sectors. Scotland's colleges, as key partners, are called to action a number of shared challenges. Specifically colleges should:

- *support implementation of the science elements of Curriculum for Excellence and the new Scottish Science Baccalaureate;*
- *enhance the match of skills, competencies and qualifications to the needs of science industries through flexible learning opportunities, tailored courses, vocational qualifications and a wide range of task-oriented competency-based learning;*
- *increase their capacity further to work collaboratively with businesses to develop science skills and knowledge programmes which enhance personal effectiveness, technical ability, productivity and support sustainable business growth;*
- *work with universities to meet the needs of learners and employers through comprehensive integrated provision, science research and knowledge transfer, while promoting skills utilisation;*
- *work collaboratively with universities to enable a stronger contribution to international development and poverty reduction through harnessing an enriched combined capacity making possible increased 'research into results' and the securing of external funding from Scottish business, UK and international sources;*

- *enhance the range of work-based vocational learning, assessment and accreditation opportunities, working in partnership with employers and Skills Development Scotland; and*
- *promote increasing participation in science, engineering and technology.*

This report explores the current provision and quality of experience for learners on life sciences programmes in Scotland's colleges and is designed to stimulate wider debate on life sciences education and training.

4 Programmes in life sciences

Life sciences comprise those fields of science that involve the scientific study of living organisms, like plants, animals and human beings. Disciplines like biology and medicine are central to life sciences but technological advances in molecular biology and biotechnology have led to an increasing number of specialised areas and new, often interdisciplinary fields. Eleven of Scotland's 43 colleges offer a significant range of life sciences programmes which allow learners to gain skills and knowledge to support employment or further study in the life sciences area. This reflects the current demand and uptake of science provision by learners providing them with sufficient choice and flexibility. A number of other colleges offer a more limited life sciences curriculum, usually entry level non-advanced provision and Higher and Intermediate level 2 courses in biology and human biology.

Of those colleges offering a significant range of life sciences programmes, most deliver programmes from SCQF levels 4 to 8. These routinely include a suitable suite of introductory level FE programmes (SCQF levels 4 to 6) and advanced level HE provision (SCQF level 7 and 8). Colleges have much freedom to develop their non-advanced curriculum to meet the needs of learners who wish to progress to careers in life sciences. The majority of colleges have developed well-considered introductory programmes at SCQF level 4 which provide learners with a basic introduction to biology, chemistry and physics and usually place an emphasis on developing core skills, particularly *numeracy*. Often these introductory programmes place an emphasis on popular images of life sciences, such as forensic investigation, to stimulate learner interest and encourage them to consider science study.

Most colleges offer well-considered science programmes at SCQF levels 5 and 6. Learners frequently study over a two year period and this allows them to develop and consolidate core skills, practical skills and underpinning knowledge. Colleges often incorporate Scottish Qualifications Authority (SQA) Scottish Group Awards (SGA) into their programmes. For example, one college includes the SGA in Science at Intermediate 2 (SCQF level 5) in the first year of its programme. Many colleges incorporate individual Higher courses, such as biology, chemistry and managing environmental resources (MER), (SCQF level 6), into the second year of programmes. This imaginative and flexible timetabling provides many learners with individual science programmes that meet their needs and interests, and enables good progression into advanced programmes.

A few colleges also offer specific FE awards in work-related areas such as dental nursing, dental technology, pharmaceutical sciences and pharmacy technicians. These programmes usually provide the underpinning knowledge for relevant Scottish Vocational Qualifications (SVQs) and meet the needs of local and national employers.

Almost all colleges offer the Higher National Certificate (HNC) Applied Sciences programme (SCQF levels 7), a generic, broad-based award which articulates with a number of HND science awards (SCQF level 8):

- Applied Biological Sciences;
- Applied Chemistry;
- Biomedical Science;
- Biotechnology; and
- Environmental Science

Most colleges also offer HND science awards, with most learners choosing the biomedical science route. However, a few colleges have sufficient learner and local employer demand to make the awards available in applied biological sciences, applied chemistry and environmental science. All of these current advanced awards were developed by SQA within the last three years with significant input from college staff and broad consultation with employers and the national sector skills council, SEMTA.

A few colleges offer specific HE-level awards in work-related areas such as dental technology, radiotherapy assistants and pharmacy services and management. This allows learners the opportunity to train for these important vocational life sciences areas in Scotland and supports employer needs.

A number of colleges deliver work-based vocational qualifications in partnership with local employers. For example, two colleges are jointly delivering the new Modern Apprenticeship in Life Sciences (SVQ 2 and 3 at SCQF levels 6 and 7) to a group of 20 medical laboratory technicians from NHS Lothian. More widely, most other colleges have started to deliver this award with a few local employers. There are a few other life sciences-related work-based vocational qualifications delivered by several colleges. These include:

- SVQ Level 3 Laboratory and Associated Technical Activities;
- SVQ Level 3 Pharmacy Technicians; and
- SVQ and NVQ Level 3 Dental Nursing.

Strong articulation links with local universities result in a few colleges offering tailored advanced awards. For example, learners gaining a university awarded Certificate of Education in Chemistry and Biology (SCQF level 7) delivered in college were able to articulate directly into the second year of the BSc degree programme of a local university. In a few instances, there is also joint delivery of these awards and learners benefit from studying and using the laboratory facilities for part of their programme in the receiving university. One college offers a *Training for Work* programme which helps graduates successfully develop a range of useful practical skills preparing them for work in bioscience industries.

Most colleges offer a valuable range of provision for local primary and secondary schools with some delivered in college facilities and some in schools or at other outreach centres. This work includes pupils from secondary schools attending college on a part-time basis to gain hands-on experience of a range of essential

practical work associated with their study of Higher and Advanced Higher biology and chemistry. A few colleges support pupils studying for the Scottish Baccalaureate in Science, who attend on a part-time basis and receive a range of assistance, including advice about project planning and management.

Partnership working with local primary schools is strong and often involves college staff supporting school delivery of topic work, such as sustainability and forensic science. The provision articulates well with the principles of *Curriculum for Excellence*. Often, the emphasis is on making science accessible and enjoyable, to encourage pupils to consider future careers in science areas. A number of colleges deliver an annual Christmas lecture to young people who are still at school. A few colleges run continuing professional development (CPD) courses for school teachers and technicians.

Almost all life sciences teaching staff deliver a number of biology and other science units to college learners on a broader range of vocational programmes, including health, nursing and beauty therapy. Often these units are delivered in the context of the vocational programme and this ensures that learners have a better understanding of relevant scientific principles.

5 Learning and teaching

Almost all learners are well motivated and work conscientiously on the tasks set for them. They use a range of resources well to support learning, including ICT. In the majority of colleges, many learners make good use of material on the Virtual Learning Environment (VLE) to consolidate and extend classroom learning. Learners also develop useful practical skills which prepare them well for future employment or further study. In practical classes, learners use laboratory apparatus and material competently and develop effective techniques for routine laboratory practices. They observe and practise high levels of laboratory safety awareness. Most learners make good progress in the time available and show confidence in their ability to follow instructions leading to successful outcomes. Where appropriate, they successfully carry out numerical tasks and write up reports of investigations built into the design of the lesson and so develop useful written *communication* and *numeracy* skills. In some programmes such as dental technology, learners work on their own for much of the time carrying out practical work, the quality of which is industry standard. Most learners display good knowledge and understanding of subject matter and work well on their own or in small groups when required. Learners also develop strong independent learning skills, through their individual practical activities.

Teaching staff are knowledgeable about the science and other specialist disciplines they teach and most have recent experience of the vocational areas with which they are associated. Most teaching staff use their subject and professional knowledge well to engage learners and relate classroom activities to industry practice. This allows them to use contemporary examples which help ensure that the lesson content is very relevant to learners' needs. Staff are also skilful at engaging learners in sharing experiences they have gained while out on work placement. The majority of teaching staff provide clear and helpful explanations and instructions, revise previous work and set objectives at the start of a lesson. They strike an appropriate balance between teacher-led activities and opportunities for learners to be actively engaged in practical work, or in working in groups or independently on relevant tasks. However, in some theory lessons staff use too limited a range of teaching approaches and do not promote active learning, with the result that learners are not fully engaged. In these classes, staff do not involve learners sufficiently in asking and answering questions, in working cooperatively in groups or in using ICT to find answers to questions and solve problems. Over the course of the year, teaching staff ensure an appropriate balance of theoretical and practical work to underpin knowledge and support the development of practical skills. They set and expect high industrial standards from learners. Teaching staff use practical work well to develop learners' skills for employability and further study. Most teaching staff provide very good support for learners and regularly check to ascertain if they are in need of additional help or challenge.

Relationships between teaching staff and learners are generally very good. This helps to create a positive and purposeful environment for learning and learners respond well to the activities on offer. Most teaching staff plan learning activities well to ensure that learners are challenged and develop appropriate skills and

knowledge. However, learners are not involved significantly in the planning of learning activities and approaches. Teaching staff receive very good support from technicians both before and during laboratory work. In a few colleges, technicians provide additional support to learners during practical classes by demonstrating laboratory techniques and showing learners how to use particular equipment. Learners appreciate this additional support. The development of core skills is well planned and usually embedded within lesson activities. Practical work and the production of written laboratory reports for completed practical work is an activity that is used very well to develop the full range of core skills. In one college, learners on access and HE programmes are given very good support and advice through a highly innovative approach to the contextualisation of *communication* skills in science programmes. This unit is delivered in the IT suite and learners are given a wide variety of different experiences including writing up lab reports, completing Universities and Colleges Admissions Service (UCAS) forms and preparing curriculum vitaes (CVs) under the supervision and with the support of two members of staff. Learners develop a wide range of IT skills as well as improving competence in *communication*.

In most colleges, facilities for carrying out practical work in science and accessing ICT are of a good standard, and learners make effective use of available equipment and resources to develop a wide range of beneficial skills. The majority of colleges have invested significantly in laboratories that are fit-for-purpose, reflecting industry standards and providing a realistic working environment for the vocational science programmes on offer. However, in some colleges facilities for carrying out practical work in science are in need of refurbishment in order to create a suitable 21st century environment and ambience. Some laboratories are in need of upgrading, including providing new benching, service facilities, seating and layout, and allowing access to ICT facilities such as desktop computers and electronic whiteboards. In some colleges, theory lessons are often carried out in laboratories which do not readily accommodate more active teaching and learning approaches. This constrains the use of more active forms of learning and creates physical barriers which obstruct the view of learners and teaching staff.

The majority of colleges have well developed VLE infrastructures. In some colleges, the VLE is appropriately populated with a helpful range of materials that support learning. This often includes lecture notes, diagrams, extension material, laboratory practical worksheets, templates and exemplars for laboratory reports, quizzes and revision material for learners to check their progress. The best VLEs also contain commercially produced learning and teaching material and links to science-related websites. However, not all learners make full use of the available materials to support and enhance independent learning. Often, this is due to learners not having easy access to ICT facilities in classrooms and laboratories or learners not having computers at home. A few colleges are in the process of developing new VLEs.

Guidance and support

All colleges provide potential learners with clear pre-entry information about science programmes on offer through their websites. Usually this includes information about the content of programmes, the entry requirements, awards gained on successful

completion and the opportunities for progression to further study or employment. College websites contain helpful information about the range of support available to learners, including financial support. Almost all learners are interviewed by college staff following application to ensure that they are placed on the appropriate programme. Many colleges formally check the level of learners' core skills at the beginning of their programme, usually with online diagnostic software, and use this information to determine any initial support learners may require. These arrangements ensure that learners have well-informed expectations about their science programmes before they begin.

Most learners receive helpful guidance and support throughout their time in college. For learners on FE programmes, this usually takes the form of a timetabled guidance period when a guidance tutor is available to support a class group. This may include class activities to further develop personal, study and employability skills. Most learners take the opportunity to set personal learning goals, reflect on their learning and assess their progress. Most colleges encourage learners to use a personal learning plan to record these processes. Teaching staff can also refer learners to college support services staff if further assistance is required, for example with *numeracy* or *communications*. Most colleges do not timetable guidance for HE learners but most teaching staff ensure that learners are appropriately supported through mainstream class activities.

Often, college-wide guidance initiatives add value to learners on science programmes. For example, in one college staff make very effective use of *Txttools* software to send *friendly text messages* and *keep in touch blogs* to monitor and support learners. This approach is used for a variety of purposes including getting information out to learners about assessments or keeping in touch with learners who have been absent or missed classes. Learners like this approach and it has contributed to successfully improving retention on programmes and in ensuring attendance at assessments.

Assessment

The assessment approaches used by life sciences teaching staff are consistent with the Scottish Government's initiative *Assessment is for Learning*, which places an emphasis on assessment ***for*** learning, assessment ***as*** learning and assessment ***of*** learning. Most teaching staff use a suitable range of ongoing assessment approaches well to check learners' understanding. They employ group questioning techniques effectively to gauge whether learners understand particular aspects of underpinning knowledge. Often, teaching staff organise learners into groups and set tasks which stimulate discussion, encourage peer learning and allow progress and gaps in learning to be identified. In one college, learners regularly use electronic voting buttons as part of team quizzes to record answers. Teaching staff are able to use the analysed data immediately to determine how well learners understand the curriculum and then reinforce any areas where gaps in knowledge are identified.

A common assessment approach that is used in almost all life sciences classes is the formal laboratory report. Most colleges require learners to write formal laboratory reports for a number of practical classes. This technique helps learners

to develop the concept of testing scientific hypotheses by experimental procedure and then formally recording and discussing the outcome. When used to best effect, this approach encourages an integrated approach to learning, developing useful laboratory skills to enhance employability and developing the five core skills of *communication*, *numeracy*, *ICT*, *problem solving* and *working with others*. All colleges promote high standards of practical laboratory work and support learners to reflect on and record their results in formal laboratory reports. College staff work with learners to provide suitable support for writing reports, such as laboratory report templates and exemplars. Often, this material is also available on the college VLE. However, in a few colleges learners struggle to meet deadlines for these reports to be submitted resulting in them not passing particular units. This may be a contributing factor to lower levels of attainment on some science programmes.

All colleges have very well-established systems to organise and manage final assessment for certification, or summative assessment. Mature internal moderation processes are verified routinely by external moderators from awarding bodies to check final assessment decisions. College staff usually coordinate assessments across the whole teaching block to try and ensure learners are not overly burdened by assessments in different subject areas within a short period of time. However, end of unit assessments tend to be in the last two weeks of teaching blocks. Where possible, teaching staff integrate assessment, both within a single unit or across two or more units. This reduces the burden of assessment for learners. Most staff give clear written feedback to learners on assessments and this supports those learners who require to re-sit the assessment. All colleges have well-signposted reassessment arrangements in place for learners.

In one college, staff are working to develop and promote a system of *e-assessment* which can be used for both formative and summative purposes and can provide feedback to staff and learners. *E-portfolios* are also being developed to monitor learners' progress while out on SVQ work placements. This supports greater flexibility for learners and allows them to keep up to date with their progress.

6 Outcomes and impact

Retention and attainment trends

Annually, colleges provide the Scottish Funding Council (SFC) with detailed data on individual learners, including: the programmes they have enrolled on; whether they have reached the date for which colleges can claim funding (25% date); whether they have completed the whole programme; and whether they have successfully attained the planned award. This data provides useful information on which to examine trends across the sector as a whole, within individual colleges and across individual subject areas. As with all statistical data, caution needs to be applied interpreting the figures but it does provide useful insights in a number of areas. For the purposes of this report, SFC data has been modified to include only those programmes that could reasonably be viewed as life sciences provision. For example, a number of colleges include their full-time Higher programmes within the science superclass and these have been removed. The following tables report on this modified data for life sciences provision and compare retention and attainment trends with the college sector as a whole. More detailed information is given in Appendix 2.

Early retention trends: 2006/07 to 2008/09

mode and level		life sciences			college sector		
		06/07	07/08	08/09	06/07	07/08	08/09
FT	FE	87%	86%	86%	88%	88%	88%
FT	HE	92%	90%	88%	92%	91%	92%
PT	FE	98%	97%	98%	97%	97%	97%
PT	HE	94%	94%	97%	95%	95%	95%

Early retention levels for full-time learners sit around the overall sector norms, although there is a slight downward trend in early retention levels for full-time HE learners. These trends support the evidence that learners are given good pre-entry information and supported well during the first few months on their programmes.

Completion trends: 2006/07 to 2008/09

mode and level		life sciences			college sector		
		06/07	07/08	08/09	06/07	07/08	08/09
FT	FE	75%	78%	78%	79%	77%	81%
FT	HE	81%	78%	79%	83%	82%	84%
PT	FE	98%	97%	96%	93%	92%	91%
PT	HE	98%	96%	94%	93%	93%	93%

Most learners on full-time life sciences programmes complete their programmes of study, although completion levels for full-time learners sit a little below overall sector norms. There is some variability across different colleges. For FE learners, curriculum teams have introduced differentiated programmes at SCQF levels 4, 5 and 6 but the full impact of this on programme completion has yet to be seen.

Success trends: 2006/07 to 2008/09

mode and level		life sciences			college sector		
		06/07	07/08	08/09	06/07	07/08	08/09
FT	FE	78%	76%	75%	81%	81%	81%
FT	HE	73%	71%	75%	81%	81%	81%
PT	FE	78%	58%	90%	91%	85%	84%
PT	HE	68%	74%	84%	83%	83%	82%

Success figures are expressed as the ratio of successful learners over those who complete the programme. Success levels for learners on full-time programmes are low, particularly when compared to overall sector norms. Again, there is some variability between individual colleges. Where individual learners fail to achieve, teaching staff spend a lot of time exploring likely reasons. For example, some learners do not complete their award during their period of enrolment, but return subsequently on a part-time basis to do so. In another college, learners who receive an unconditional offer for university during their HNC year do not always complete all the assessments for the HNC award. Attainment levels for part-time learners are improving and remain in line with overall sector norms.

Wider achievement

Learners take the many opportunities during study on life sciences programmes to develop and gain a range of wider personal and social skills. Most learners gain useful employability skills through the development of practical skills during laboratory work and working with other team members. These include:

- effective time management;
- planning and organising;
- the ability to think critically and creatively; and
- the ability to learn and continue learning.

Some learners, particularly those at HE level, also develop these skills through visits and optional work placements to local hospital and university laboratories. Close links with associated industries and international partners are important in allowing learners to gain a broader understanding of the workplace and the kind of skills that are considered important to prospective employers. Most learners also gain valuable citizenship skills during their programmes. These are often developed during project work where issues of local, national and international interest can be explored and discussed. Many life sciences learners gain useful skills through taking part in the delivery of school/college programmes. For example, in one college the science department won an *SQA Star Award* for innovation in relation to the development of presentational skills by HE learners. The learners went out to schools and gave presentations to pupils using scientific language appropriate to the age of the audience. In most colleges, learners benefit from opportunities to go on visits to places of scientific or industrial interest or from listening to invited guest speakers.

Progression

Most learners who successfully complete life sciences programmes progress to further study or employment. In general, FE learners tend to progress to further study since most FE life sciences programmes are designed as preparation for further study at HE level. In specific vocational areas, such as programmes for dental nurses and pharmacy assistants, many FE learners progress directly into employment, often as a result of successful work placements.

All colleges have clear progression routes which allow learners to progress from introductory programmes to HND programmes within the same institution. In addition, almost all colleges have very good articulation arrangements with local universities. Most learners use their HNC award to gain entry into the first year of a science degree programme or their HND award to gain entry into the second year of a programme. A few colleges have very good *2+2* arrangements where learners with an HND can progress directly to the third year of an honours degree programme. Usually these arrangements are specific to particular degrees and may involve a bridging unit, often delivered by university staff during the HND year.

7 Enhancement through self-evaluation and internal review

All science programme teams are committed to improving the quality of the learner experience and the use of self-evaluation and internal review as tools for enhancement and improvement. Within these teams, most teaching staff are involved in formal self-evaluation activities which include programme team meetings and reporting. However, in a few colleges self-evaluation reports are completed by curriculum managers with little or no input from teaching staff. This reduces the effectiveness of the process because not all staff feel involved and able to contribute to discussion on a range of curriculum matters.

Science curriculum teams use a number of methods to seek the views of learners on the quality of provision. All colleges have class representatives as members of programme review teams. Most learner representatives consult with classmates before review meetings and feel able to raise issues about learning and teaching. All colleges use end-of-unit questionnaires to seek learner opinion on learning and teaching issues. However, some of the questionnaires are limited in the range of issues covered. Some colleges hold useful focus group sessions with learners. Overall, the views of learners are well represented in the evaluation of learning and teaching. Learners are able to describe examples of where their feedback has led to change. These include team teaching introduced for the delivery of some units, including communications and the graded unit, and changes made to the sequencing of assessments.

Most programme teams consider learner data and performance indicators for early retention, learner completion and learner success as part of the internal review process. However, only a few teams analyse this data rigorously enough, particularly where low retention or attainment exists. Often, this simply includes a description of individual learner circumstances rather than an exploration of possible underlying reasons for low performance. Most colleges produce detailed self-evaluation reports which record strengths, areas for development and action points for improvement under key elements and quality indicators. However, not all reports are sufficiently evaluative, particularly in the consideration of learning and teaching. Most reports do not contain actions to improve and enhance learning and teaching. For example, most colleges do not have in place systems of peer observation or encourage staff to observe the delivery of lessons by colleagues in order to broaden their understanding of what constitutes good practice in learning and teaching.

8 Recommendations

Scotland's Colleges should:

- improve opportunities for college staff in the science curriculum area across Scotland to share and extend good practice.

Colleges should:

- support teaching staff to develop a broader range of teaching strategies and approaches that encourage more active learning and engage learners more fully;
- improve learning and teaching approaches to involve learners more actively in planning and managing their own learning;
- ensure that science laboratories and facilities are fit for purpose and reflect industry standards; and
- improve success levels for learners on full-time science programmes through rigorous analysis of underlying reasons for low performance and implement measures for improvement.

HMIE should:

- continue to monitor progress made with the above recommendations through their annual engagements with colleges, and disseminate information on key improvements as they emerge across the sector.

Appendices

Appendix 1

Colleges visited in the fieldwork for this report

- Aberdeen College
- Adam Smith College
- Coatbridge College
- Dundee College
- Edinburgh's Telford College
- Forth Valley College
- James Watt College
- Stow College

Appendix 2

Table 1: Life sciences programmes
Summary of data over three years

The following information, gathered from data submitted to SFC by colleges and adapted as appropriate, relates to life sciences early retention, completion and attainment over the last three years. The focus is on the number of full-time and part-time learners on FE and HE programmes. Some individual learners will have enrolled on more than one programme, particularly for part-time provision.

2006-07

Mode	Level	Enrolled	Funded	Completed	Succeeded	Early retention	Completion	Success
FT	FE	704	612	456	354	87%	75%	78%
FT	HE	508	468	378	275	92%	81%	73%
PT	FE	6630	6510	6405	4997	98%	98%	78%
PT	HE	278	262	258	175	94%	98%	68%

2007-08

Mode	Level	Enrolled	Funded	Completed	Succeeded	Early retention	Completion	Success
FT	FE	581	497	386	292	86%	78%	76%
FT	HE	375	337	264	188	90%	78%	71%
PT	FE	3659	3550	3441	1980	97%	97%	58%
PT	HE	220	206	197	146	94%	96%	74%

2008-09

Mode	Level	Enrolled	Funded	Completed	Succeeded	Early retention	Completion	Success[4]
FT	FE	869	743	583	435	86%	78%	75%
FT	HE	468	411	326	245	88%	79%	75%
PT	FE	7415	7274	6959	2587	98%	96%	90%
PT	HE	244	236	222	187	97%	94%	84%

[4] In 2008-09, SFC revised the definition of success, to take account of programmes which were designed where learners were not to be assessed. This has most impact on part-time FE programmes where many are designed not to include assessment.

Appendix 3

Portraits of excellent practice

FE science programme design: *scaffolding units*

Curriculum managers at Adam Smith College have successfully introduced additional support for learners on full-time FE science programmes through changes in the design of the programme. They have achieved this by introducing non-assessed units called *scaffolding units* which help learners develop wider skills and consolidate learning. Learners on the first year of the NC Access to Science programme (SCQF level 5) study towards the SQA National Certificate Group Award in Science. This creates space in the programme to deliver additional classes. During these classes, learners participate in a number of projects and activities which help to develop team building and citizenship skills. For example, learners investigated issues such as recycling and the dangers to albatross birds. They produced slide presentations and raised wider college awareness by displaying the presentations on large video screens in the college atrium. They also collected used stamps across the college to support the RSPB *Save the Albatross* campaign. Learners enjoy the investigations and feel they get to know each other better and it encourages group working. The introduction of *scaffolding units* has also improved retention and attainment by increasing learner motivation.

Integration of *communication* into FE science programmes

Curriculum managers at Dundee College have designed a blended learning approach that integrates the SQA units on Communication and Science and Technology in Society. Two *Access to Science* classes meet together as one group with two science teaching staff who team teach in a large computer laboratory. All learners have access to a computer with internet capability. Once they have agreed their assignment topic with staff, learners work at their own pace researching and scoping the task. They build up their assignment using appropriate sources including the Internet and, where necessary, receive support and advice from teaching staff. Draft assignments are word processed and can readily be altered if revision is required. Time saved by this blended approach is used for writing laboratory reports, completing UCAS forms and CVs, preparing presentations, and completing learner development plans. As well as gaining knowledge and understanding of science, learners develop important skills in *communication*, IT and research. The contextualisation of *communication* into the science programme has proved beneficial in many ways. It has led to significant improvements in attendance. All work is word processed and learners submit assignments ahead of schedule. Making core skills vocationally relevant in this way has proved popular with learners and may well be extended to other programmes.

Articulation and joint delivery partnerships with local universities

Learners on science programmes at Stow College benefit from the strong articulation links and joint delivery partnerships with local universities. Learners successfully completing FE access programmes can gain direct entry to degree-level programmes in human nutrition, podiatry, radiography, optometry and degree and diploma nursing at Glasgow Caledonian University. A few learners gain direct access to the degree in medicine or medical studies at the University of Glasgow. Strong links with other local universities also enable learners completing HNC programmes in Applied Science to articulate into the first or second year of a wide range of life sciences degree programmes. Teaching staff at the college deliver a Certificate of Education in Chemistry and Biology (SCQF level 7) which guarantees successful learners direct entry to second year of a range of science degrees at the University of the West of Scotland. The college successfully negotiated with Glasgow Caledonian University to co-deliver the BSc Clinical Physiology degree and learners are now benefiting from shared facilities and broader inputs to learning and teaching.

Engaging with young learners in primary and secondary education

Over the last year, more than 3,500 young learners have benefited greatly from participating in a wide range of activities offered by science staff at Forth Valley College. As well as involving primary and secondary pupils in hands-on science activities, such engagement helps raise the profile of science as a career choice. Younger pupils have participated in *World of Work* events and the annual *Science, Engineering and Technology Fair* at Grangemouth Stadium. Science staff at the college run weekly practical sessions for pupils studying Advanced Higher Biology and Chemistry, allowing them to gain first hand experience of equipment and technical expertise not readily available in schools. Sixth year pupils taking the Scottish Science Baccalaureate are supported by college staff who help with project planning, arranging guest speakers and organising visits to places of scientific interest. Science learners attending the college also benefit from this engagement with school pupils. Many have signed up as *science ambassadors* and are involved in planning and running workshops and giving presentations to pupils using language appropriate to the age of the audience. This partnership working with primary and secondary schools has helped build scientific capacity within the local communities.

Fishy Partnership: Intermediate 2 Biology learners working in partnership with *Sealife Loch Lomond Aquarium*

Learners taking the Intermediate 2 Biology course at James Watt College are working in partnership with *Sealife Loch Lomond Aquarium* to carry out a research project which links with the Environmental Biology unit of their course. Following initial discussion with *Sealife* staff, learners planned and carried out a project on the behaviour and colour preferences of lumpsucker fish which spawn in the sea around Scotland. The outcomes of this project will be of direct value to *Sealife* as well as

providing a good example of environmental preference and habitat adaptation which are learning outcomes in the Biology course. The project allows learners to gain confidence in their research skills and experience hands-on learning relating to real life situations. Learners work together carrying out observations and maintaining livestock and equipment with minimal support from staff. Teaching staff have noted improvements in learner motivation, interest and commitment. Learners carry out much of the work in their own time, including maintaining aquaria and agreeing a rota for attendance at college during non-teaching weeks. One of the outcomes of this project is a formal report which should help *Sealife* to make decisions about suitable habitats and aquarium conditions for this species of fish.

High quality industry-standard learning and teaching facilities for dental nursing

Learners on dental nursing programmes at Coatbridge College gain essential practical skills using high quality industry-standard learning and teaching facilities. The college has recently invested in a suite of 16 individual dental stations that allow learners to develop the full range of practical skills required to provide support to dentists. Each station is equipped to industry standard and includes a *phantom head* on which learners can practice various procedures. Teaching staff can simulate various patient dental conditions and learners then learn and practise the correct procedures to deal with them. The teaching staff station has a video camera linked to the learner stations and learners observe at their own station the procedures carried out by the teacher on the *phantom head*. Teaching staff can monitor the whole class easily and provide support to those learners requiring additional help with particular procedures. Teaching staff set high professional standards and ensure that learners match these. Learners enjoy using the high-quality learning facilities and the time and space to develop essential practical skills at their own pace.

Innovative use of ICT in simulation training of laboratory practical activities

Learners on life sciences programmes at Aberdeen College use a wide range of online training packages, both college-devised and commercial, to enhance their laboratory skills. Often learners use these packages to develop knowledge and first level skills prior to actual laboratory work and perform virtual practice of key skills in time outwith the class. This helps learners more readily gain a satisfactory level of laboratory skills during limited laboratory time and learners often progress more speedily to more advanced practical skills. Some learners also use the packages during practical activities to provide virtual coaching and support if they are unsure of a technique or approach. For example, a training package on distillation contains video and supporting text on laboratory method and theory; an online marked quiz; interactive software *drag and drop* apparatus assembly; searchable glossary; and video plus activities on industrial applications. Learners gain important employability skills when using these packages as virtual laboratory packages are increasingly becoming regular practice for analytical instrumentation training in industry.

Appendix 4

Glossary of terms

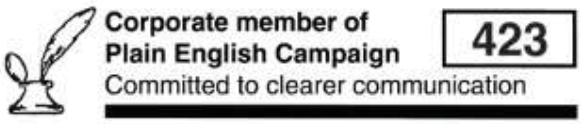
BSc	Bachelor of Science
CPD	Continuing Professional Development
CV	Curriculum Vitae
FT	Full-time
FE	Further Education
HE	Higher Education
HMIE	HM Inspectorate of Education
HNC	Higher National Certificate
HND	Higher National Diploma
ICT	Information and Communications Technology
IT	Information Technology
MER	Managing Environmental Resources
NC	National Certificate
NHS	National Health Service
NVQ	National Vocational Qualification
PT	Part-time
RSPB	Royal Society for the Protection of Birds
SCQF	Scottish Credit and Qualifications Framework
SEMTA	Sector Skills Council for Science, Engineering and Manufacturing Technologies
SET	Science, Engineering and Technology
SFC	Scottish Funding Council
SGA	Scottish Group Award
SQA	Scottish Qualifications Authority
SVQ	Scottish Vocational Qualification
UCAS	Universities and Colleges Admissions Service
VLE	Virtual Learning Environment

www.hmie.gov.uk

Further information is available from:

HM Inspectorate of Education
Denholm House
Almondvale Business Park
Almondvale Way
Livingston
EH54 6GA

Tel: 01506 600 200
Fax: 01506 600 337
Email: enquiries@hmie.gsi.gov.uk



INVESTOR IN PEOPLE

ISBN 978 0 7053 1323 0