Education Scotland
Foghlam Alba

Computing and Digital Media

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A subject-based aspect report by Education Scotland on provision in Scotland's Colleges on behalf of the Scottish Funding Council

Transforming lives through learning

Scottish Funding Council
Promoting further and higher education

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1. Introduction and methodology

Introduction

Education Scotland's publication, *External quality arrangements for Scotland's colleges*, *updated August 2013,* specifies that HM Inspectors will produce a number of subject aspect reports over the four-year period 2012-16.

Colleges should act on the recommendations contained in these reports. College inspectors will monitor action towards implementation of recommendations as part of their normal dialogue with colleges. They will wish to discuss issues arising from subject aspect reports during annual engagement visits.

This report evaluates college programmes which deliver education and training in computer and digital media technology, rather than in computer usage. These programmes sit within the Scottish Funding Council (SFC) and Education Scotland subject category Computing and ICT (Information and Communications Technology). Throughout the report, we refer to these as computing programmes. Programmes covered by this report are offered through a variety of modes of delivery at levels 4 to 8 of the Scottish Credit and Qualifications Framework (SCQF). The report evaluates current practice and identifies important areas for further development amongst practitioners. It provides case studies of effective practice and sets out recommendations for improvement.

The report notes progress made in relation to recommendations within a previous report, *Computing in Scotland's Colleges*[1] published in 2009 by then HM Inspectorate of Education (HMIE). It makes minor reference to the recommendations in another report, *Creative Digital Industries in Scotland's Colleges*[2], also published by HMIE in 2009.

In preparing this report, inspectors visited the six colleges listed in Appendix 1 and drew on the findings of published HMIE and Education Scotland external reviews of colleges. They examined other relevant publications and reports, which helped to establish an industry and Government perspective. They elicited the views of key stakeholders, including the Scottish Qualifications Authority (SQA), representatives of higher education institutions and employers.

Methodology

Each college in the sample was visited twice during the fieldwork. Inspectors and associate assessors observed learning and teaching and discussed relevant issues with managers, teaching staff and learners. The initial visits to colleges helped to identify areas of focus for the subsequent visits. This enabled a number of themes to be explored which had been identified the first time round, along with a detailed examination of case studies. For example, following the initial visits it was clear that in four of the six colleges, recent merger would have an impact on staffing and management structures, and consequently on planning of computing programmes. Second visits also focused on how colleges were using analysis of programme

[1] http://www.educationscotland.gov.uk/inspectionandreview/Images/sbarco_tcm4-712910.pdf
[2] http://www.educationscotland.gov.uk/inspectionandreview/Images/sbarcdi_tcm4-712909.pdf

performance in 2012-13 to improve programme delivery. The task team obtained the views of stakeholders through face-to-face discussions and through telephone contact.

Two dissemination events, one in February 2014 and the other in June 2014, set out interim and more complete findings of the report. This ensured that the views of staff from all colleges influenced the findings. The report was also discussed during an event for college heads of computing departments held by SQA in January 2014 and with the SQA Sector Panel for Computing in September 2014.

Inspectors carried out a desk analysis of relevant documents relating to computing. This included an analysis of performance indicator (PI) data, self-evaluation documents and internal review information. The task team also analysed several national reports and strategy documents relating to the ICT and Digital Technologies industry sector. Conclusions from this deskwork are contained within the report.

2. Summary of key findings

Key industry and employability themes:

- The ICT and Digital Technologies industry sector makes a significant contribution to Scotland's economy. The sector is characterised by rapid growth and continuous change.

- Currently, there are major skills shortages within the industry workforce. In particular, there is a shortage of young people and women entering employment in this sector. Skills shortages will likely increase in the future.

- Scottish Ministers have articulated an ambition to be a world leading digital nation by 2020. This ambition is set out within key documents[3] which support the Scottish Government's strategy for supporting the digital economy.

- The *Skills Investment Plan for Scotland's ICT and Digital Technologies sector*[4]*, (SIP)* published by Skills development Scotland (SDS) in March 2014, sets out very clear actions for education providers and employers to work more closely together to ensure that the pipeline of talent meets growing demand. This is reinforced by publications from both E-Skills[5], the sector skills council and Scotland IS[6], the industry trade body.

- Most entrants to the ICT and Digital Technologies sector are degree-level graduates. At present, most college learners at SCQF level 7 and 8 intend to progress to university rather than enter directly into employment.

- Post-16 reform in Scotland is predicated on enhancing the place of employability in education. Key messages from *Education Working for All!*[7]*,* the final report of the Commission for Developing Scotland's Young Workforce, are also likely to adjust the focus of many college programmes.

- Within the past year the SQA has carried out revisions to key computing awards at SCQF levels 4 to 8, to reflect industry developments.

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

- Almost all managers and teaching staff involved in computing programmes have a strong awareness of industry trends, developments and future skills requirements. Most staff incorporate current industry practice well into learning activities.

- There are many well-established and successful partnership arrangements which support learner progression from college to university. Effective liaison between

[3] http://www.scotland.gov.uk/Resource/Doc/981/0114237.pdf
[4] http://www.skillsdevelopmentscotland.co.uk/media/987939/ict___digital_technologies_sector_skills_investment_plan.pdf
[5] Technology Insights 2012, Scotland, e-skills UK
[6] Scottish Technology Industry Survey 2013, Scotland IS
[7] http://www.scotland.gov.uk/Publications/2014/06/4089

most colleges and universities has influenced programme design and delivery, which has prepared learners well for degree-level study.

- In most colleges, the design of National Certificate (NC) or National Qualification (NQ) computing programmes leads to the development of sufficiently broad, relevant skills and knowledge. There are many examples of effective delivery of core skills in computing programmes at NC or NQ level.

- Almost all colleges design computing programmes at SCQF levels 7 and 8 which reflect clearly the skills base required by partner universities or local employers.

- Almost all computing departments have responded well to the recommendations in the 2009 HMIE report *Computing in Scotland's Colleges*. As a consequence, learning and teaching has improved overall, including in challenging subject areas like programming.

- Most learners engage well with learning activities and are keen to make progress with their studies. Learner work is generally of a high standard and many learners, particularly on Higher National Certificate (HNC) and Higher National Diploma (HND) programmes develop very impressive technical knowledge and skills.

- A strong feature of much computing delivery on Higher National (HN) programmes is the joint exploration and sharing of technical knowledge between staff and learners. As well as fostering positive and egalitarian relationships, this nurtures effective co-creation of learning.

- Learners benefit from an increased number of opportunities to participate in learning activities which help with the development of appropriate workplace and personal skills.

- In most programmes teaching staff plan and carry out ongoing assessment to support learning and assessment for certification well.

- Overall performance in all modes and levels of computing programmes apart from part-time further education (FE) has improved over the past four years. Sustained improvement in learner early and further withdrawal rates have made a significant contribution to this.

- Most learners progress to related further study from college programmes, with a small number entering employment.

- In all colleges, computing staff have a strong commitment to improving programme performance and they carry out quality enhancement processes thoroughly. Most computing staff are responsive to the views of employers, higher education representatives and learners.

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

- Inclusion of mathematics in college computing across the sector varies greatly. The importance of mathematics in college computing programmes is an issue which requires further discussion and agreement at a national level.

- Computing departments have not all attempted rigorously enough to involve employers in programme design and delivery in a way which is mutually beneficial.

- Occasionally the pace of learning, particularly on NC or NQ classes, can be too slow or insufficiently challenging. Learning in theory or demonstration classes can also occasionally be too passive, with long periods of teacher exposition.

- The uptake of vendor qualifications across colleges varies widely. This has a potential impact on the perceived employability of learners. Most computing staff consider that there needs to be more consistent arrangements across the sector, either through further links between SQA and vendor qualification providers or through clearer college policies on their adoption.

- Colleges could do more to challenge learners to apply in-depth analytical or problem-solving skills, develop creativity or integrate knowledge in open-ended tasks, in order to develop the skills needed for such a fast-changing sector.

- More needs to be done by colleges to ensure that learners enrolling on computing programmes are fully aware of programme content and progression opportunities at the application and recruitment stage.

- Colleges do not always ensure that learners are aware of employment or apprenticeship options and pathways, either directly from college study or beyond university.

- There is a very significant gender imbalance on college computing programmes, with almost all learners male.

- Most colleges recognise that instilling awareness of employability, personal attributes and capacity to reflect on learning needs more imaginative and contextualised approaches than are currently provided.

- Although overall performance in full-time computing programmes has improved, there is significant variation both across and within colleges. Performance in full-time computing programmes also sits below the national sector performance levels for all FE and higher education (HE) programmes.

- There are instances of continuous low programme performance not being addressed sufficiently rigorously, either in self-evaluation reports, or within programme internal review processes.

- In most self-evaluation reports, there is insufficiently robust evaluation of learning and teaching and only very occasionally are links made between low performance indicators (PI) and the quality of the learning experience.

3. Background and context

The ICT and Digital Technologies industry sector makes a significant contribution to Scotland's economy and has an important role to play in its future success. Across all employment sectors, in Scotland and further afield, effective and innovative digital technology is one of the most crucial factors in potential economic development. Currently in Scotland, the ICT and Digital Technologies sector contributes over £3bn to the Scottish economy. It employs more than 73,000 people with approximately 29,000 working in ICT or digital technology organisations, and another 44,000 in ICT roles in other sectors. The sector is characterised by rapid growth and continuous change, which makes involvement with it exciting but challenging. For prospective employees, there are many opportunities not only to develop worthwhile careers, but also to be involved in contributing to Scotland's global economic impact.

Over the past few years in almost all developed economies, the digital landscape has changed significantly in its impact on life and work. For example, ownership and use of mobile devices is now almost universal in certain demographic groups and contributes significantly to people's participation in society. The requirement in the private and public sector for advanced digital technologies to support business processes is very clear. This includes generating, managing and analysing data, interacting with customers and ensuring financial efficiency.

Scottish Ministers have articulated an ambition to be a world leading digital nation by 2020. This ambition is set out within key documents which support the Scottish Government's strategy for supporting the digital economy and has been supported by several interrelated initiatives which aim to support the development of the ICT and Digital Technologies sector. These include the Government's key strategy documents *Scotland's Digital Future A Strategy for Scotland*[8], published in 2011 and a subsequent update in 2013: *Supporting the Transition to a World-leading Economy*[9]. These documents set out clearly the Government's ambitions to enhance the role of digitisation in business, public and private life, and to enhance digital literacy across Scotland. The latter report also details the Government's position in relation to the supply of skills within the digital sector.

> *'Sustaining economic success within an increasingly competitive digital economy requires a workforce with the skills and confidence to harness the potential of Digital Technologies to drive growth, stimulate innovation and improve productivity. This requires Scotland to ensure that it can both call upon the number and range of IT and Telecoms professionals required to support the digital economy and enjoy levels of digital literacy across the whole of our workforce that enable us to recognise, deploy and use Digital Technologies to transform business operations and service delivery.'*
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> *Scotland's Digital Future - Supporting the Transition to a World-leading Digital Economy, published May 2013*

These strategy documents recognise that all potential development in the ICT and Digital Technologies sector is underpinned by the need for increasing levels of high-quality skills. All strands of the Government's digital strategies and plans align

[8] www.scotland.gov.uk/Resource/Doc/981/0114237.pdf
[9] www.scotland.gov.uk/Publications/2013/05/2347

with this ambition for enhancing both professional and personal digital literacy skills across the nation. The Government has recently established the *Digital Scotland Business Excellence Partnership*, with representation by key partners, including Scottish Government, Education Scotland, Skills Development Scotland (SDS) and SFC to provide strategic leadership, strengthen partnerships and make best use of available resources to realise the step change required.

Industry representatives agree that the current and future workforce needs people who are not only technically competent, but able to scan, interpret and respond creatively to the developing economic, social and digital landscape. Emerging specialist areas, including cloud computing, cyber security, ethical and environmental issues, big data and increasing use of mobile and web technologies, are all creating strong demand for highly specialist skills.

Despite the current buoyancy of the sector in Scotland, many employers are experiencing serious skills gaps and shortages in their ICT and Digital Technologies workforce, particularly in highly specialist areas like software development. These shortages will become even more acute over the next few years, as an ageing workforce reaches retirement age. SDS is seeking to address this, in partnership with industry representatives, through the *Skills Investment Plan for Scotland's ICT and Digital Technologies sector*, (SIP) which was published in early 2014. This document sets out key actions aimed at ensuring that the right quantity and type of skills will be available to meet growing demand.

The SIP recognises that the pipeline of talent, whether in schools, colleges or universities, is coming under increasing pressure. Because of the high level of technical and intellectual capacity required, most entrants into the sector are either university graduates or move into specialist areas from other skilled work-based roles. The SIP sets out a clear message that study of computing at pre-degree level is very important, in order to attract people into the workforce at an early stage of their education. A decline in the number of young people opting to study computing in schools and a flat-lining recruitment trend for full-time programmes in colleges, is offset to an extent by recent growth in uptake of degree-level places. A very significant gender imbalance has resulted in only a small number of females either studying or working in digital technology areas. Actions contained within the SIP are drawn up under four themes:

- Responding to the immediate need for ICT and digital technology skills.
- Broadening the future talent pipeline for ICT and digital technology skills.
- Working together to make the education system more responsive to the needs of employers.
- Raising the profile of the ICT and Digital Technology sector and careers.

Many supporting actions in the SIP focus on enhancing the links between education and industry sectors. These themes are also echoed within key publications by e-skills UK[10], the sector skills council, and Scotland IS[11], the industry trade body.

[10] Technology Insights 2012, Scotland, e-skills UK
[11] Scottish Technology Industry Survey 2013, Scotland IS

In colleges in Scotland, training for the ICT and Digital Technologies sector falls largely to programmes under the subject category Computing and ICT. Throughout this report, we refer to these broadly as computing programmes.

Over the past few years, there have been several major changes within the education landscape, which impact on the work of colleges. Post-16 reform[12] in Scotland, including the college regionalisation programme, is predicated on an increasing drive, through Regional Outcome Agreements, to enhance employability across all sectors. The regionalisation process means that there are now 26 colleges operating within 13 regions. These include 11 large institutions which are the result of recent mergers. Increasing productive links between education providers and employers is also promoted very clearly in *Education Working for All!* the final report of the Commission for Developing Scotland's Young Workforce, published in 2014. The likely impact of all of these initiatives on the design and delivery of college programmes, including in computing, is considerable. The introduction of new national qualifications in the Senior Phase of Curriculum for Excellence has a potential impact on the capacity and expectations of entrants to college programmes.

This sets out the industry and educational context within which programmes in computing in Scotland's colleges need to operate. To summarise, colleges recognise that computing programmes need to:

- develop appropriate knowledge, understanding and technical skills for industry or progression to further learning;
- enhance employability and extend employer links;
- encompass future industry developments; and
- instil in learners the capacity to learn and develop throughout their careers.

[12] http://www.scotland.gov.uk/Topics/Education/post16reform

4. Programmes in computing

Introduction

Computing programmes represent 8% of all college programmes in Scotland and are offered by 23 of the 26 colleges in Scotland. As detailed earlier in this report, as a result of mergers, many computing departments are now very large, and will take time to establish a full suite of programmes with coherent entry levels and pathways. Most computing staff in merged colleges view this as a positive opportunity to review and refresh computing programmes and ensure they meet better the needs of their local and regional economy. Colleges which have not undergone merger also review their programmes regularly, to align them to the demands of industry. Entry requirements for programmes at all levels are mostly appropriate

Almost all managers and teaching staff involved in computing programmes have a strong awareness of industry trends, developments and future skills requirements. Managers and staff recognise fully the emphasis placed on development in Science, Technology, Engineering and Mathematics (STEM) and the vital place of ICT and Digital Technologies within all of these areas. Many staff have led or been involved in the design of new HN qualifications. Most computing programme leaders are also involved in highly effective sharing of intelligence and material with colleagues in other colleges.

Case study: effective use of computing consortia to support college provision

For the past few years, managers and staff in computing departments have worked very effectively together with colleagues in other colleges, through well-established consortia. The primary intention of these groups is to develop and strengthen computing in colleges, provide united representation to relevant industry and education bodies and support the delivery of vendor qualifications. They also ensure that expertise and innovation across the sector are shared and that colleges develop unified approaches to programme delivery. This has benefited college computing learners wherever they study in Scotland.

There are two main consortia in Scotland. These are the Scottish Colleges Computing Consortium, known as S3C and the IT Providers Consortium Scotland (ITPCS). ITPCS, hosted by Glasgow Clyde College is specifically for colleges which are Microsoft IT Academies, but, while focusing primarily on the delivery of Microsoft qualifications, also holds events which focus on wider issues within the computing sector. S3C and ITPCS members have collaborated on the development of materials for the revised SQA HN awards, which has proved efficient and helpful. They also benefit from joint training events and reduced fees for vendor qualifications. Both of these consortia have enhanced greatly the sharing of information about new developments. Importantly, they ensure that the collective views of college practitioners are represented in discussions about the future development of computing provision.

Range of programmes

The computing curriculum in Scotland's colleges is largely based on qualifications provided by SQA[13]. A small number of colleges also offer qualifications provided by other awarding bodies, including City and Guilds and the British Computing Society. An increasing number of colleges offer degree programmes, validated by different universities. These fall outwith the scope of this report. Most colleges also offer industry-accredited vendor qualifications, either as standalone part-time programmes or as an optional qualification within full-time programmes. The main vendor qualifications offered by colleges focus on networking technologies, database management and use of IT applications. More detail about the uptake of these is provided below.

Programmes at SCQF levels 4,5 and 6

There is a wide range of awards on offer at these levels. This includes the Scottish Group Award (SGA) NC Digital Media Computing, introduced in 2007. This award has undergone significant revision over the past year, following consultation with colleges. It will be re-launched for session 2014-15 with the title NC Computing with Digital Media. There is a fairly even split between the colleges which currently offer the SGA NC Digital Media Computing and those which offer locally-devised NQ programmes, in both cases usually at SCQF level 5. A few colleges also offer SCQF level 6 programmes or incorporate level 6 units into level 5 programmes, to bridge the gap between them and Higher National Certificate (HNC) programmes. However, this is not common practice, and too many learners still find the move to HNC programmes daunting. A few colleges make good use of National Progression Awards (NPA), comprising clusters of two or three units grouped under specific themes, within full-time and part-time programmes. Learners undertaking NPAs can build up certification quickly, which enhances their motivation. A few colleges offer useful introductory programmes at SCQF level 4 to learners with low entry levels of computing skills. For example, North East Scotland College incorporates City and Guilds IT User and ICT Systems awards into its introductory programmes.

In most colleges, the design of NC or NQ computing programmes ensures a good foundation for progression to the college's suite of specialist HN programmes while also supporting the development of more broadbased skills and knowledge. Learners enter these programmes from a wide variety of backgrounds, and can often be very young. There are examples of very effective delivery of core skills, particularly communication, in computing programmes at NC or NQ level. Numeracy also forms an important part of almost all computing programmes at this level. However, it is not always contextualised, and, as delivered, its relevance is not always apparent to learners. A few colleges offer entry-level programmes in computer games design or similar, which are based largely on the non-technical aspects of computer games. Study on this type of programme can be enjoyable, successful and build in useful transferable skills. This makes these programmes useful for attracting hard-to-reach learners to college study. However, occasionally there are limited opportunities for learners to progress to a suitable next level of study, or the move to specialist technical programmes is too challenging for these learners.

[13] http://www.sqa.org.uk/sqa/files_ccc/Progession_Routes_from_Computing_Awards.pdf

Programmes at SCQF level 7 and 8, and above

Over the past two years, SQA has revised four key awards at SCQF levels 7 to 8 and introduced a new one. SQA aims to ensure, through extensive consultation with industry, universities and colleges through its Sector Panel for Computing, that awards are up to date and reflect current and future industry requirements. Because of rapid and continuous changes within the industry, and a rather slower pace of change within SQA, this naturally presents challenges. Within award hierarchies, there is scope to introduce new units throughout the life of the award, which helps to maintain their currency.

The first of these revised awards is the HNC in Computing at SCQF level 7, configured in some colleges as year one of the relevant HND. This award enables an element of specialism straightaway or more general study in computing. Most colleges have just completed delivery of the HNC stage of these revised qualifications and will deliver year two in session 2014-15. The revised HND hierarchies in computing are:

- Computing: Software Development;
- Computing: Technical Support; and
- Computer Networking

The most recent addition to the computing suite of qualifications at SCQF level 8 is HND Computer Science. This qualification is mainly for those wishing to acquire a more general range of skills across the spectrum of software development and technical support specialisms. Uptake of HND in Interactive Media remains strong, especially for colleges which have strong design provision and have good links to degree programmes in web design. It will be revised in 2014-15. A small number of colleges also offer HND Computer Games Development. HND Information Technology falls outwith the scope of this report as it focuses mostly on computer usage rather than in computer technology. Most colleges welcome the development of the new HN awards and consider that they are much more up to date than before. However, opportunities to incorporate vendor qualifications within SQA HN awards have been reduced, which, as discussed later in this section, has caused concern in some colleges.

Almost all college programme design at SCQF levels 7 and 8 reflect clearly the skills base required by partner universities or local employers. Most learners studying HN programmes in software development, networking, interactive media and computer games development intend to progress to university, because they recognise that this is the main route to employment. However, not all are able to do this and a number of learners wish to enter employment directly from college. Learners most easily progress directly into employment from HNC/D Technical Support programmes. Most computing staff recognise that there are particular challenges in designing programmes which support a parallel progression route. An example of colleges responding well to their local environment is the adoption of the new HND in Computer Science across all University of the Highlands and Islands partner colleges. This addresses the generalist computing skills needed in the small to medium enterprises (SME) which form the bulk of employment in that area of Scotland.

Part-time programmes

These programmes offer a wide range of awards, including vendor qualifications, NPAs at SCQF levels 4,5 and 6 and Professional Development Awards (PDA) at SCQF levels 7 and 8 which, like the NPAs, consist of clusters of two or three specific units. By far, the greatest uptake of part-time programmes involves upskilling in computer usage, for example the European Computer Driving Licence (ECDL) or PC Passport, all of which fall outwith the scope of this report. However, a few colleges also offer part-time programmes to school learners, either in the form of NPAs or, occasionally part-time clusters of units at SCQF level 7. *Education Working for All!* emphasises strongly the need to increase the number of work-based learning opportunities. Many colleges offer part-time study to employed learners, either on standalone programmes or on an infill basis to full-time programmes. These usually involve units at SCQF level 7 or 8. At present, there is low uptake of Modern Apprenticeship programmes in computing within colleges, though a number of private training providers are involved in this area. A few colleges have successfully offered this programme over the past few years and more are exploring the possibility.

Case study: Modern Apprenticeship programme

There is a growing demand for on-the-job training in computing-related areas across Scotland, likely to increase with the publication of Education Working for All!. New College Lanarkshire has pioneered Modern Apprenticeship training with one of its key partners, a major national bank. The two-year programme was established in early 2013 in response to concerns within the bank about workforce succession planning. The programme is delivered by combining workbased training with a weekly day-release program. All the apprentices undertake a number of HN Units at SCQF Level 7 and 8, concurrently with the Competence Based Qualification in IT and Telecomms (SCQF Level 6). Currently, 15 apprentices are undertaking this programme, but there are plans for many more to be involved in the forthcoming year. A particular feature of the programme is that each apprentice undertakes units individually tailored to meet the requirements of their workplace role. This involves a high degree of differentiation within programme delivery.

The first set of apprentices are all on track to gain the HND Software Development in early 2015. Having learned from the experience of the first year of the programme, the college is responding to a request for delivery of a wider range of skills for a second cohort. Apprentices will initially undertake the HNC in Computing and then undertake an HND in Software Development or in Networking. Apprentices will also complete relevant vendor qualifications, selected to enhance their work-based roles.

The college hopes to provide the Modern Apprenticeship programme to other partners. It is also currently in negotiation with the Open University, to offer a third year software development degree programme, also on a day-release basis.

5. Partnership working

Articulation to and from college programmes

Most colleges are monitoring with growing concern the decline in uptake of programmes in computing in schools and its potential impact on the number and capability of learners who apply for college programmes. Learners who progress to college directly from school, even with Higher Computing, often struggle with the demands of HNC programmes, especially in programming. A small number of colleges promote computing well in schools through offering successful Skills for Work and taster programmes or by holding computing promotional events. However, most colleges recognise that in the light of *Education Working for All!* there is considerable scope to enhance partnerships with schools, and therefore stimulate young people's interest and capacity to undertake specialist study in computing.

Case study: Promoting computer games technology in schools

West College Scotland has a strong track record of working with local primary schools to promote enjoyment of computing and games technology. For example, children have acted as clients for college learners as they develop educational games. The college is also well known for its pioneering work with children in programming, which has made this challenging subject accessible and fun. An example of its activities is the KoduKup Scotland. This is a UK competition sponsored by Microsoft and West College Scotland, which has the backing of Computing at School[14] and the College Development Network[15].

The competition encourages young people from schools across Scotland to become interested in programming from an early age. It challenges school pupils aged 7 to 14, in teams of 3, to create a game using the Microsoft development tool Kodu. In June 2014, the top ten teams were invited to West College Scotland, Paisley Campus to compete in a final day of building, presenting and judging. The judging panel consisted of high-profile specialists from industry and education. This injected a real sense of industry standards into the competition, which made it demanding but rewarding for the young people involved. Importantly, all the children, young people and school teaching staff involved now have a much clearer sense of what the computer games industry is about, and an increased enthusiasm for further learning in that sector.

Most computing departments work effectively in close partnership with universities to ensure smooth articulation from college programmes. This includes adjustment of programme design so that it prepare learners effectively for university, with increasing levels of problem-solving, independent learning and presentation of projects included within HN programmes. Partnerships between the University of the West of Scotland and New College Lanarkshire, the Robert Gordon University and North East Scotland College and the University of Dundee and Dundee and Angus College work particularly well. Many colleges also offer successful degree-level

[14] http://www.computingatschool.org.uk/
[15] http://www.collegedevelopmentnetwork.ac.uk/development-networks/cdn-home

programmes themselves, in most cases through a 2+1 or 2+2 model, with degrees validated by a university. Several Scottish universities work very well with college computing departments through the Associate Student scheme[16]. Most university representatives consider that, in general, college computing learners are well prepared for degree-level study and progress with appropriate levels of knowledge and skill.

Case study: Effective partnership working between college and university

Dundee and Angus College is the lead partner in several collaborative projects funded through the Tayside and Fife Articulation Hub. College and university staff have worked together very effectively to develop a number of initiatives which enhance learner employability skills, support articulation and provide useful professional development for staff. These initiatives include programmes in computing. Very effective partnership arrangements established between Dundee and Angus College and the University of Dundee benefit college learners studying computing at HN level, and also benefit degree-level learners and staff from both institutions. This initiative is known as the Computing and Vendor Exchange. It aims to support the progression of learners in their last year of HN study into local degree programmes by enabling them to experience lectures and workshops at the university. This helps college learners to be more fully prepared for progression. In turn, the partnership enhances the employability of university learners by supporting them to undertake vendor qualifications at the college. In establishing the partnership, staff from both institutions have carried out much joint discussion and analysis of the needs of all learners studying computing. This has helped staff from each institution to understand the requirements of each education sector much more clearly. Importantly staff also now share knowledge and understanding of industry requirements and of the skills needed by learners as they embark on their careers.

There is one major aspect of progression which is not fully resolved across colleges and universities. Many universities demand high-level capacity in mathematics from learners, either because it forms part of degree content, for example in software development, or because it is a good indicator of a learner's capacity for computational thinking. However, mathematics at the level required for progression to degree-level study from HNC and HND programmes is a very challenging proposition for many learners, who may not have previous qualifications in that area. Most colleges do not offer optional, discrete units in mathematics in HNC or HND programmes, preferring to embed it into practical projects. While many learners might attain their HNC or HND more easily this way, the importance and place of mathematics in college computing programmes requires further discussion and agreement at a national level. A few colleges are planning to tackle this issue in the near future, either by working much more closely with mathematics teaching staff to ensure that the appropriate levels are achieved, or by revising their qualification frameworks to incorporate maths more comprehensively.

[16] The scheme is for learners studying HNC/D programmes in colleges which articulate with advanced standing to degree programmes. Associate students have access to university facilities and build up experience of university study throughout their college programmes.

Case study: Inclusion of mathematics in programme design

Forth Valley College recognises that delivery of mathematics in computing programmes needs to be reviewed and refreshed. This has followed extensive discussions with employers, including those involved in the computer games industry, who consider that knowledge and skill in mathematics is a primary factor in employability. One of the key barriers experienced by college computing learners has been a lack of appropriate levels of foundation mathematics provision within in programmes at SCQF levels 5 and 6. This has caused problems when these learners progress to HN programmes and beyond, particularly when specialising in software development and computer science. The college has therefore adjusted the delivery of mathematics in the NC/NQ programmes and is now embedding appropriate levels of SQA National Qualifications in mathematics within programme design. For example, SCQF level 5 students will undertake Intermediate 2 Mathematics, (or equivalent) with the examination optional. At level 6, learners will study the whole or part of Higher Mathematics. Within HN programmes in software development and computer science the college will incorporate routinely the optional mathematics units which sit within the award frameworks. In considering how mathematics will be delivered in HN programmes, the college is drawing on its expertise in the delivery of mathematics for engineering programmes. In this way, the college is addressing with direct action the difficulties faced by STEM learners in coping with mathematics and progressing with the right knowledge, understanding and skills.

Employability

Most computing staff incorporate current industry practice well into learning activities. This is an aspect of programme design which has improved significantly over the past few years. Many colleges make good use of live projects, team-working, guest speakers and units which involve client interaction to reinforce learner understanding of industry requirements and behaviours. In Glasgow Clyde College, for example, learners benefited from a presentation by police computer forensics experts, which helped them to contextualise their study in that area. In many colleges, computing staff also encourage HN learners to carry out their graded unit using a live project. The new HND award suite includes topical units in ethical hacking, cyber security and forensic analysis. SQA is currently considering the development of PDAs in key emerging specialist areas. Learners find that these units are relevant and enjoyable, and generate useful discussions about wider social and employability issues.

There are many examples of positive initiatives which incorporate industry practice.

Case study: Work experience through helpdesk project

In North East Scotland College, computing staff have established a highly-effective work experience project for computing learners studying at Aberdeen City Campus. With an increase in the number of learners bringing their own computer device across all areas of the college, a clear need has emerged for helpdesk support to ensure that different devices can be used effectively within college premises. The college enlisted the support of its college computer support provider, RM Education to support this initiative. The resulting ITHelpzone operates within college hours. It is staffed by year one HND Technical Support learners who have been selected and trained by RM. They provide advice and technical support either face-to-face or through a telephone helpline. The additional training by RM builds on existing skills developed through learners undertaking Microsoft certified courses as part of HN programmes. Uptake of the service by learners, and occasionally staff, is considerable, with up to 100 calls logged in a single day. Customer feedback on the responsiveness, reliability and expertise of the advisors is very positive and the service is now an integral part of the college facilities for learners. There are significant benefits for the learners involved in the project. Over half of them have subsequently secured jobs in IT support with involvement in the ITHelpzone giving them the work experience that employers seek. There are plans to extend the service to the Fraserburgh Campus and to increase the range of services provided.

Case study: Effective use of real-life industry scenarios in programme design

Computing learners on HN programmes in Forth Valley College develop useful skills in analysing customer requirements and devising relevant solutions. They do this through the use of scenarios, which mirror real-life industry project briefs and are based on the very recent industry experience of some staff. Teaching staff make use of simulated client briefs which are presented in a typical way, as broadly-expressed IT problems. Learners draw on knowledge and skills gained across their whole programme to work out what is needed and how to take the project forward. They work in teams to develop and present well-considered solutions within tight deadlines. An example of a project was a local SME setting up a cloud computing service and wishing to integrate it with their existing IT services. In another example, learners were asked to design a solution prototype for a secure network to support a small online retail company enlarging their business. In a third example, a school was seeking help to develop a computer game to help young people practise their mathematics skills.

Each project team is required to use industry-standard work breakdown structure analysis to ascertain which tasks will be carried out in order to meet the client's requirements. Involvement in these projects helps learners develop key employability skills, which is very important as they look ahead to future careers. Most learners also find undertaking this work enjoyable, fast-paced and highly relevant to industry practice.

Case study: Applying technical knowledge and skills within a social enterprise

In Perth College UHI, learners on NC Digital Media Computing work closely with a social enterprise based within the college. This has provided learners with a range of useful employability skills. The WEEE (Waste Electrical and Electronic Equipment) Centre's primary function is to process used equipment from local businesses and individuals. It is also the recycling and reuse centre for all Perth College UHI equipment. The computers received by the Centre are refurbished and re-sold, or provided on a charitable basis to local individuals and charities. Any profits from this work are re-invested in the enterprise. Learner involvement with the WEEE Centre commenced on a voluntary basis in early 2013. Because of its success, involvement with the centre has expanded to become embedded within the work of the NC programme. During the academic year 2013-14 all learners experienced three or four short placement sessions. During their placements learners apply the knowledge and skills they have gained during hardware and networking classes, which form part of the NPA Computer Networks & Systems. Involvement in this process has helped the learners not only to apply their technical skills, but to understand more effectively the importance of sustainability. In the next phase of the project, the college plans to formalise learners' work with the WEEE centre so that it can contribute to summative assessments for relevant units.

Case study: Enhancing employability through participation in competitions

National and international research suggests that participation in competitions can be a very positive experience for college learners. Learners from a number of Scotland's colleges have enjoyed success when entering for the Worldskills UK[17] competitions in IT, computing and other subject areas. New College Lanarkshire has been very successful, coming top of the UK league in 2013. Learners from Glasgow Clyde College have also been successful in competitions in networking and technical support, reaching the UK finals in each of the last three years, and winning the Scottish heats in the last three years. Participation has helped these learners to work towards a world-class standard of vocational skills during 12-18 months of intensive training. As well as technical competencies, learners develop effective skills in problem solving, team working and time management. This has made them more confident, improved their attention to detail and enhanced their capacity to take responsibility and make decisions. As a result, learners have enhanced greatly their professional competencies, which prepares them very well for future employment.

Glasgow Clyde College has adopted WorldSkills approaches by establishing an inter-college competition which, as far as possible, replicates the complexity, pressure and accuracy required to succeed in the national events. Participating learners in these competitions are overwhelmingly positive about the impact on their technical and personal skills. They have also extended their personal and potentially professional networks by working with learners from other colleges. The college has plans to extend the range of competitions to include local universities and employers.

[17] http://worldskillsuk.org/

However, despite increased incorporation of industry practice within projects, many colleges still experience difficulty in building productive partnerships with local employers. This means that direct contact either with the ICT and Digital Technologies sector or other industries forms little part of too many computing programmes. HNC or HND computing learners often have insufficient direct experience of industry, either in the form of work placements, industry visits or guest speakers and miss opportunities to develop transferable employability skills. In some cases this is because employers expect to recruit only degree-level graduates and do not appreciate fully the advanced knowledge, skills and abilities of HND learners. In some instances, employers only work with colleges on specific projects and do not welcome further engagement. However, computing departments have not all attempted rigorously enough to engage employers in programme design and delivery in a way which is mutually beneficial. In the HMIE report of 2009, *Creative Digital Industries in Scotland's Colleges,* there were examples of direct involvement with employers in design and delivery of programmes, with significant benefit to learners and employers which could apply equally well to computing departments. Only a few computing departments have noted and addressed this possibility. E-Skills and Scotland IS run a very effective work placement scheme called E-placement Scotland[18]. However, currently, it focuses mainly on providing work placement opportunities for university-based learners rather than those studying at college.

The uptake of vendor qualifications across colleges also varies widely. This can impact significantly on the perceived employability of learners, which is particularly important for those not intending to progress to degree-level study. Most employers (and some universities) value vendor qualifications highly because of their reputation for rigour and challenge and because they provide a clear indication of a learners' capability in specific skills. SQA has a number of arrangements in place with leading global companies which enables the awarding of vendor qualifications on achievement of specific HN units. These arrangements are established through the Digital Media and IT Vendor Alliance (*DIVA*)[19]. However, while many colleges offer vendor qualifications, including in a few instances at SCQF level 5 and 6, other colleges find it difficult to do so. This can be because of lack of capacity amongst teaching staff, because vendor qualifications are no longer as easily embedded within HNC and HND awards, or because there is an additional cost implication for the college or for learners. Most computing staff consider that there needs to be more consistent arrangements across the sector, either through further links between SQA and vendor qualification providers or through clearer college policies on their adoption.

[18] http://www.e-placementscotland.com/
[19] http://www.sqa.org.uk/sqa/68089.5089.html

6. Learning and teaching

The HMIE report *Computing in Scotland's Colleges,* published in 2009, signalled very clearly several areas for development in learning and teaching, with a recommendation that colleges prioritise addressing them. Since then, almost all computing departments have responded well to the recommendations. As a consequence, learning and teaching has improved overall, though there remain some areas which require further attention.

Learning process

In most classes at every level, learners engage well with learning activities and are keen to make progress with their studies. Learner work is generally of a high standard with many HN learners in particular developing very impressive technical knowledge and skills. Amongst almost all learners, there is a clear preference for practical or project-based activities, but many also respond well to theory sessions. While the majority of learners carry out written elements of coursework to the required standard, this tends to be the least successful aspect of their learning.

Many learners who undertake computing study, particularly at HNC and HND level, are subject enthusiasts, who spend much of their own time exploring their subject, often using *opensource* software. Many also learn very effectively in college, working alone at workstations. This mode of self-learning, when well supported by high-quality coaching approaches, helps learners to builds the appropriate analytical, problem-solving and independent learning skills required in industry. Learners work with increasing levels of independence, personalisation and choice as they progress through levels, though choice tends to be limited to personal responses to pre-ordained tasks. Many learners use online material or workbooks effectively to acquire underpinning practical activities. For example, in North East Scotland College Aberdeen City Campus the virtual learning environment (VLE) makes a significant contribution to effective learning, and includes helpful video clips, programme information and collaborative forums.

Most learners support each other well, sharing knowledge or working through problems together, on occasions using social media effectively. Learners benefit from an increased number of opportunities to participate in group activities in, for example, dedicated HN units like *Working in a Project Team*. This supports the development of appropriate employability and personal skills. Many learners work productively in group projects, but more needs to be done to ensure that all learners participate, including those who are naturally shy and not good at contributing to group discussions. In some computer rooms, the layout of workstations makes groupwork difficult. On occasions, group activities are not designed or managed well and do not support effective learning.

Teaching process and planning of learning

Almost all teaching staff ensure that their knowledge of sector requirements and of technological developments is as up to date as possible. Most undertake continuous professional development regularly, much of it in their own time. Computing staff recognise the challenge of maintaining the currency of their knowledge and expertise

and many would welcome more opportunities to update their skills through industry work experience.

Computing staff apply their expertise and enthusiasm for their subject well in most classes through good planning, sequencing and integration of learning activities. In most classes, though not all, staff make clear to learners the purpose of the learning activity and usually provide clear links to prior learning. Staff often make good use of learner enthusiasm and knowledge in classroom discussions, particularly on HNC or HND programmes. As well as fostering positive and egalitarian relationships between staff and learners, this nurtures genuine co-creation of learning.

Many computing staff recognise the intellectual challenges of computing study and explore ways of sustaining learner motivation through more difficult subjects.

Case study: Motivating learners through a *gamification* approach

Computing staff at North East Scotland College have developed a successful approach to motivating learners by making use of the type of rewards and incentives found in computer games. They have based this on research which suggests that instant visual rewards encourage endeavour and support improvement. Learners undertaking certain units in the NC Digital Media Computing programme are awarded online 'badges', similar to those used in computer games, for attainment in class activities, either individually or in groups. This allows them to receive instant, visual feedback, through which they can see exactly what they have achieved and what they still have to complete. Badges can be awarded for specific and sometimes quite short pieces of work and can be built up quickly. This means success is celebrated immediately. The badges scheme has been used with the NC units Still Images and Video Acquisition and Games Design and Media Assets. In the video unit peer-reviewed badges were awarded by the learners themselves. The scheme provides effective incentives which are motivating and fun. It even generates healthy competition between learners to see who could get the most or highest level badges. Computing learners respond particularly well to this because many are so familiar with how computer games are designed. One learner stated:

'this has helped me to get my work up to the required standard and submit work on time which is something I didn't do adequately enough before. This has got me focused on putting the hours in to get on to the HND next year.'

Teaching staff have made significant improvements in devising learning activities which are more active, collaborative and stimulating than in 2009. However, in NC or NQ classes occasionally the pace of learning is too slow and learning activities are insufficiently challenging. In too many classes at this level, there is little evidence of differentiation, which means that learners who are well ahead do not benefit from extension work, and those who are struggling do not receive additional support. Furthermore, in a few classes, as was also reported in 2009, teaching staff set tasks and leave learners for overly-long periods of self-study, with minimum intervention. This can mean that staff miss opportunities to discuss, evaluate or extend learning. In general, colleges could still do more to challenge learners to apply in-depth analytical or high-level problem-solving skills, develop creativity or

integrate knowledge in open-ended tasks. Given the challenges and rapidly evolving skills demanded by the industry, this is an area for development in many class learning activities.

The majority of teaching staff take care to explain challenging theoretical or technical concepts carefully and build on prior learning. This enables learners to build up their knowledge and understanding in stages. However, learning in theory or demonstration classes can occasionally involve over-long periods of teacher exposition. When this happens, staff miss opportunities to engage learners in exploring ideas and draw on their existing knowledge. Most staff use questioning well to reinforce learner understanding and encourage learner discussion. However, they do not always involve all members of the class in answering and only rarely do staff use open-ended questioning techniques very well to extend learners' higher-order thinking skills. Programming is probably the area that presents the greatest difficulty for learners. There is a range of object-oriented programming languages on offer across the sector, most commonly Java, C++, and C#, depending on what articulating universities or local employers require. Computing departments have improved the delivery of programming overall, though staff also recognise that the subject could be made still more accessible to all learners. Because of the increasing presence of programming in some primary schools, colleges also anticipate that the mystique surrounding this area will dissipate over time. Most colleges introduce foundation knowledge in programming skilfully in NC and NQ programmes, break the subject down into manageable sections and devise helpful exercises projects which help learners to practise and apply practical programming skills.

Resources

The standard of accommodation for computing varies across colleges, though most computing departments make good use of what they have. However, lack of space means that many computing rooms are rather cramped. Only a few have flexible breakout space in which learners can gather and work together, but where this is available it supports effective learning. Most computing suites are well-equipped with up-to-date hardware and software. The perennial problem of investing in resources in a climate of budget reductions exercises all colleges. In a few colleges, learners complain about the slowness of college PCs and the limited amount of storage available to learners. Learners on programmes in technical support require to work with actual hardware, which can sometimes be out of date. Some colleges are beginning to employ a *bring your own device* approach, which learners value. However, success in this venture is dependent on learners owning high-quality devices which can be connected to efficient and accessible college Wi-Fi systems.

Guidance and support

College prospectus information about computing programmes is generally accurate and provides helpful detail about programme content. However, at times, the multiplicity of titles, for NC and NQ programmes in particular, can lead to prospective learners misunderstanding programme content and applying for programmes which do not meet their needs. Furthermore, learners are sometimes encouraged to study computing programmes by school guidance staff or parents without the challenges

and complexities involved being fully appreciated. This may occur because learners enjoy recreational use of computers, mobile technology or computer games.

Several colleges have carried out useful and extensive work over the past years to make sure that the programme offer is clear and does not raise false expectations, in learners, parent and schools. This helps to address priorities in Regional Outcome Agreements which require that the right learners are placed on the right programmes. However, colleges ascribe most learner drop-out to misplaced expectations about the content of computing programmes and there is more to be done to ensure that learners enrolling on computing programmes are fully aware of what they are taking on. For example, not all colleges carry out pre-entry interviews or skills tests. As a consequence they miss opportunities to assess genuine learner interest in the subject and potential to cope with challenging programme content.

Case study: ensuring learners are prepared for college study

In North East Scotland College computing staff recognised that some learners who had been interviewed for college programmes before the summer break did not take up their college place at the start of term. Staff therefore decided to hold a day in June where applicants could find out more about programme content and about the college, and feel motivated to take up their place. The learners worked in groups and used Aurasma technology to trigger short, informative videos by scanning specific images within the college website. Each video provided the links to the next one. This engaging approach enabled learners to access key information about their future college experience, while working in groups and getting to know their future classmates. The videos used were created by staff and contained information about key departments of the college. The June pre-induction day was very successful, with a significant increase in the number of learners who turned up for the beginning of term. The learners felt they were made welcome and were much more confident about embarking on college study. They valued seeing round the building when it was quiet, meeting the staff and finding out more detailed information about their programme.

Positive, supportive relationships between staff and learners develop in most programmes. In many programmes, teaching staff provide effective guidance on progress, through regular one-to-one review sessions in which targets for improvement are agreed. However, this is inconsistent across colleges and learners occasionally express frustration about lack of regular review of their progress.

Colleges vary greatly in how they provide more formal guidance and support sessions. Whole-class guidance sessions often address employability, enterprise or personal reflection themes. However, computing learners, including those in higher-level programmes do not always value generic personal study and often consider that it takes time away from their main interest. Most colleges recognise that instilling awareness of these important areas of employability, personal skills development and capacity to reflect on learning may need more imaginative, contextualised approaches. Almost all colleges provide very good information and advice about progression to universities. However, they do not always ensure that learners are aware of employment options and pathways, either beyond university or

directly from college study. In most colleges, more could be done to ensure that learners are fully aware of how the ICT and Digital Technologies sector is developing, and the range of skills, knowledge and personal attributes this will require.

Colleges support learners with additional support needs well. In a few colleges, learners for whom English is not their first language find the technical language used on computing programmes difficult. Most teaching staff are sensitive to the additional needs of these learners, but occasionally staff do not provide learners with sufficient support, and learners have to rely too much either on translation software to make sense of key words and phrases, or on other learners to translate for them.

Assessment

In most programmes teaching staff plan and carry out ongoing assessment to support learning and assessment for certification well. Most colleges are trying to integrate assessments in order to reduce the pressure on learners, but also to encourage them to apply knowledge and understanding. Most learners are clear about assessment schedules, and manage assessments well. Most teaching staff provide helpful oral or written feedback but in a few programmes feedback on submitted work is too slow and does not support identification of next steps. There are examples of overly-relaxed application of submission deadlines in a few colleges, and instances of learner frustration when deadlines are not rigorously applied.

In most colleges, learners use ICT well to undertake assessment. As well as using it to pose technical problems, some teaching staff also make good use of online quizzes or multiple choice questions. Learners find that this helps them to reinforce their knowledge well. Assessment of vendor qualifications is almost always carried out online and learners find this rewarding, especially when feedback is instantaneous. Many learners make good use of their college's VLE to view the progress they are making on previously submitted assessments and, in a few colleges, to build e-portfolios. Most colleges prepare learners well for the rigours of their examination-based graded unit on the HNC Computing programme through a mock examination.

In order to prepare learners more effectively for assessment practice at university, which is largely based on written examinations, several colleges are participating in an SFC-funded SQA project *Piloting 'Enhancements' to HN Qualifications to Support Articulation*[20] for specific HND computing units. These approaches aim to assess knowledge and skills from across more than one unit and support learners to develop effective written examination techniques.

[20] http://www.sqa.org.uk/sqa/63217.html

7. Outcomes and impact

Performance indicator tables for all modes of delivery over a four-year period are presented below.

Full-time further education (FE)

Computing and ICT					
	Initial	Early Withdrawal	Further Withdrawal	Partial Success	Success
2009-10	2973	12%	18%	17%	53%
2010-11	2758	10%	18%	15%	58%
2011-12	2829	10%	16%	13%	62%
2012-13	2472	9%	15%	13%	63%
National Sector Performance					
		Early Withdrawal	Further Withdrawal	Partial Success	Success
2009-10	-	10%	18%	13%	60%
2010-11	-	10%	17%	11%	62%
2011-12	-	9%	16%	11%	64%
2012-13	-	9%	15%	11%	65%

Part-time FE

Computing and ICT					
	Initial	Early W/drawal	Further Withdrawal	Partial Success	Success
2009-10	41065	3%	5%	10%	82%
2010-11	34700	2%	5%	8%	85%
2011-12	21187	2%	4%	8%	85%
2012-13	13160	3%	6%	12%	79%
National Sector Performance					
		Early W/drawal	Further Withdrawal	Partial Success	Success
2009-10	-	4%	7%	13%	76%
2010-11	-	4%	7%	12%	77%
2011-12	-	3%	6%	12%	79%
2012-13	-	4%	6%	12%	77%

Full-time higher education (HE)

Computing and ICT					
	Initial	Early Withdrawal	Further Withdrawal	Partial Success	Success
2009-10	3540	8%	16%	16%	60%
2010-11	3622	6%	14%	17%	63%
2011-12	3764	6%	13%	14%	68%
2012-13	3622	6%	13%	14%	67%

National Sector Performance					
		Early Withdrawal	Further Withdrawal	Partial Success	Success
2009-10	-	7%	15%	14%	64%
2010-11	-	6%	14%	13%	67%
2011-12	-	6%	12%	12%	69%
2012-13	-	6%	12%	12%	70%

Part-time HE

Computing and ICT					
	Initial	Early Withdrawal	Further Withdrawal	Partial Success	Success
2009-10	1139	10%	6%	23%	62%
2010-11	1138	5%	4%	17%	74%
2011-12	722	5%	5%	19%	71%
2012-13	553	3%	5%	15%	77%
National Sector Performance					
		Early Withdrawal	Further Withdrawal	Partial Success	Success
2009-10	-	5%	6%	16%	73%
2010-11	-	4%	6%	15%	75%
2011-12	-	4%	6%	14%	75%
2012-13	-	4%	6%	14%	76%

Enrolment trends

In 2012-13, just under 2500 learners undertook full-time FE programmes categorised under computing and ICT, a decline of 500 over a four-year period. In full-time HE programmes, numbers of enrolments have remained reasonably stable over a four year period, and in 2012-13 were approximately 3500.

However, over a four-year period, there has been a sharp decline in part-time enrolments, particularly at FE level, from just over 41000 in 2009-10, to just over 13100 in 2012-13. This declining trend for part-time computing programmes is in line with a more widespread decline in all part-time enrolments across the college sector. Part-time HE enrolments have almost halved in the same period, from approximately 1100 in 2009-10, to just over 500 in 2012-13. Many colleges suggest that learners undertaking part-time HE study are usually in employment and have experienced difficulties sustaining employment or finding time to undertake such a commitment.

Performance trends

Performance on full-time programmes in computing and ICT has improved considerably since the HMIE report *Computing in Scotland's Colleges* of 2009. Successful completion rates for full-time FE computing programmes, based on day one enrolment figures and aggregated for Scotland, have improved from 53% in 2009-10, to 63% in 2012-13. In full-time HE programmes, successful outcomes have also improved, from 60% in 2009-10 to 67% in 2012-13. Success rates on

part-time FE programmes have declined slightly over a four-year period, but they have improved significantly in part-time HE programmes. A major contributor to improved success outcomes, is that over a four year period, in both full-time FE and HE programmes, learner withdrawal rates have reduced, and are now mostly in line with national sector performance levels. Colleges have worked very hard to ensure that learners remain on programmes over the past few years.

Although improvement in full-time programmes is very welcome, there are issues and caveats which need further analysis. While success rates for both full-time FE and HE programmes have improved, both figures for 2012-13 still sit below the national sector performance level for all full-time FE and HE programmes, which are 65% and 70% respectively. The national sector performance figures have also demonstrated steady improvement over four years, so programmes in computing and ICT need to do still more to catch up with, or preferably overtake, the national figures. Another issue is that the overall figures for computing programmes disguise some significant variations in performance by individual colleges, within programmes across departments, and, of course, across legacy campuses in newly-merged institutions.

Analysis of enrolments and performance by equalities categories

Data tables for enrolments and performance by equalities analysis are presented in appendix 2.

Gender

The most significant indicator in relation to equalities is the low female uptake of full-time computing programmes and a declining trend in female part-time FE learner enrolment over a four-year period. Almost five times as many male learners as females study on full-time programmes in computing. This is very evident in classes in computing, where it is not uncommon for there to be no female learners at all. There are more female part-time learners than male, but this is mainly in FE programmes. Representation by female learners on part-time HE programmes is very low.

On full-time FE programmes in 2012-13, female learners performed slightly less well than their male counterparts. This was due to higher levels of female early withdrawal than the rate for males. Apart from that, there was little difference in overall performance in relation to gender.

Age

More 16 to 19 year olds study computing than any other age group, with the proportion of this group having increased from 21% to 30% over a four year period. The proportion of learners in both the under-16 and the over 41 group has declined significantly over the same period. Successful outcome rates for all learners increases directly with age, with the most successful group by far learners over 41.

Disability

There is a slightly higher proportion of computing learners with a disability than in the sector as a whole, 17% for computing as against 14% for the sector. This proportion has increased over a four year period, and appears to counterbalanced by a decrease in learners who do not know whether they have a disability. Disability has little perceptible impact on success rates.

Ethnicity

The proportion of learners, and their success rates on computing programmes is in line with national patterns.

Progression into further learning or employment

There is no nationally generated data for the number of computing learners who progress from colleges to higher levels of study or into employment. All data is generated by the colleges themselves, and relies on central college systems for tracking learners or on the personal knowledge of teaching staff. There is also no national system for tracking learners beyond their first post-college destination, which makes it difficult to assess the longer-term impact their college training has had on their careers. Some colleges are building databases of former learners. On occasions, former learners return to speak to current learners about their career progression, which is useful and motivating.

In the colleges visited for the fieldwork for the report, on average, 75% of learners completing computing programmes at SCQF level 8 progress to degree-level study at local universities. Progression varies from entry to year three, year two, or even year one of a degree programme, depending on the HND studied, the articulation agreement in place, and sometimes the level of the graded unit. Of the remainder, approximately 5% enter employment directly from college, with the rest either seeking employment or with unknown destinations. There is no data available for the number of learners who enter employment at a later stage, for example six months or a year after leaving college. Anecdotally, many learners carry out freelance work when leaving college and combine this with other employment or further study. The current development of apprenticeship programmes for the IT industry at SCQF level 8, has the potential to provide learners with HNC or HND qualifications with progression routes into employment from college. A few colleges are currently exploring this progression route in more depth.

Almost all learners who complete successfully college programmes at SCQF levels 7 and below progress to higher levels of learning within the college. A few HNC learners progress to university, entering either at year one or two of a degree programme, or they may move to an HND programme at another college. It is rare for learners to enter employment directly from HNC programmes or from NC or NQ programmes.

8. Enhancement through self-evaluation and review

In recently-merged colleges, computing staff across the different campuses are currently planning the future curriculum. Many of these plans will include stringent review of past performance as a basis for continuation of programmes in the new college portfolio, as well as the sharing and comparing of legacy practice. Colleges which have not undergone merger also regularly review and refresh their approaches to quality enhancement.

Almost all staff carry out quality enhancement processes thoroughly in informal team discussions, internal review meetings, regular programme team meetings or through self-evaluation reporting. Computing staff are highly responsive to the views of employers and university representatives. Most computing programmes have a class representative who carries out this role well and most staff are responsive to the views of learners. However, in a few programmes, learners have not been asked for their views, and as a result quite serious concerns have not been aired or addressed. Examples of this have included unreliable hardware, slow feedback on assessment and the impact of staff shortages.

Most self-evaluation reports contain detailed analysis of PIs and exploration of causal factors. However, there are a few programmes where continuous low performance over a period of years has not been addressed sufficiently rigorously, either in self-evaluation reports, or within college internal review processes. In most self-evaluation reports, there is insufficiently robust evaluation of learning and teaching and only very occasionally are links made between low PIs and the learning experience. This is of concern, given some of the areas for development in relation to learning and teaching detailed earlier in this report. Many staff could do more to explore good practice in learning and teaching, either in computing departments or in other subject areas, and apply it within their own programmes. Many reports detail actions to improve pre-entry guidance and recruitment processes which is helpful given some of the issues raised earlier in the report.

Most computing staff acknowledge that there are major challenges in designing programmes and learning activities which keep up with the pace of change in industry. Many staff are upskilling in areas unfamiliar to them at great speed, in order to maintain the delivery of programmes when key staff have moved on. Furthermore, as with industry, many colleges find it hard to attract computing teachers with the right level of qualifications and expertise. Nevertheless, most computing staff across the college sector remain highly enthusiastic about their subject, committed to improvement in their programmes, and very focused on learner success.

9. Recommendations

Colleges should:

- work together with key stakeholders to establish clearly the place of mathematics in computing programmes and ensure that learners are able to undertake mathematics learning at the level required for progression or employment.

- plan and deliver learning activities which provide appropriate pace and challenge and which engage all learners.

- develop in learners analytical, problem-solving and creativity skills at an appropriate level within learning activities.

- ensure that involvement of employers in design and delivery of computing programmes is enhanced so that all computing learners develop appropriate transferable employability skills.

- ensure that learners are aware of, and well prepared for employment options and pathways in the ICT and Digital Technologies sector, either directly from college study or beyond university.

- support learners to understand the importance of employability skills and reflection on learning, through appropriate learning and guidance activities.

- improve performance in computing programmes where it is low.

- ensure that robust evaluation of learning and teaching, and appropriate actions to enhance it, features in all programme team quality processes.

Education Scotland should:

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

- address the actions contained in the *Skills Investment Plan for Scotland's ICT and Digital Technologies sector*, as a partner within the *Digital Scotland Business Excellence Partnership.*

- work with colleges and other agencies to promote study of computing to young people and to address the gender imbalance.

Scottish Government should:

- support the development of the IT and Digital Technologies sector through facilitating effective partnerships between education, skills development and business sectors.

The College Development Network should:

- draw on the findings of this report to support colleges in taking forward the recommendations.

Appendix 1

Colleges visited in the fieldwork for this report:

Forth Valley College

Glasgow Clyde College

New College Lanarkshire (pre April 2014)

North East Scotland College

Perth College UHI

West College Scotland

Appendix 2

Equalities data

% Enrolments by gender

Computing and ICT				
	2009-10	2010-11	2011-12	2012-13
Female FT FE	3%	2%	3%	3%
Female PT FE	43%	41%	38%	33%
Male FT FE	8%	9%	13%	13%
Male PT FE	29%	28%	21%	23%
Female FT HE	2%	2%	4%	3%
Female PT HE	1%	1%	1%	1%
Male FT HE	11%	13%	18%	20%
Male PT HE	3%	3%	3%	3%

Successful outcome by Gender, Mode and Level

	Early withdrawal	Further withdrawal	Partial success	Success
Female FT FE	11%	15%	13%	61%
Female PT FE	3%	7%	16%	74%
Male FT FE	9%	15%	13%	63%
Male PT FE	4%	8%	17%	71%
Female FT HE	7%	12%	9%	72%
Female PT HE	2%	10%	10%	79%
Male FT HE	6%	13%	15%	66%
Male PT HE	4%	4%	16%	76%

% Enrolments by age

Computing and ICT				
	2009-10	2010-11	2011-12	2012-13
Under 16	11.4%	9.5%	4.5%	4.0%
16 - 19	21.0%	23.2%	27.4%	29.5%
20 - 25	11.0%	12.6%	14.9%	15.7%
26 - 40	18.4%	19.9%	20.2%	19.3%
41 and over	38.2%	34.7%	33.0%	31.4%

Successful outcome by age

Computing and ICT				
	Early withdrawal	**Further withdrawal**	**Partial success**	**Success**
Under 16	3%	24%	18%	55%
16 - 19	5%	12%	17%	66%
20 - 25	8%	11%	15%	66%
26 - 40	6%	8%	13%	72%
41 and over	3%	6%	14%	77%

% Enrolments by disability

Computing and ICT				
Disability Status	2009-10	2010-11	2011-12	2012-13
Disability	14.7%	16.0%	16.6%	17.4%
No known disability	79.4%	77.9%	81.8%	81.4%
Unknown	5.9%	6.0%	1.7%	1.3%

Successful outcome by disability

Computing and ICT				
Disability Status	**Early withdrawal**	**Further withdrawal**	**Partial success**	**Success**
No known disability	5%	14%	10%	71%
Dyslexia	6%	16%	11%	68%
Other Disability	6%	19%	10%	65%
Other Unseen	7%	16%	8%	69%
Unknown	4%	21%	10%	64%

% Enrolments by ethnicity

Computing and ICT				
Ethnicity category	2009-10	2010-11	2011-12	2012-13
	95.0%	95.0%	95.2%	95.0%
Ethnic minority	5.0%	5.0%	4.8%	5.0%

Successful outcome by ethnicity

Computing and ICT				
Ethnicity category	**Early withdrawal**	**Further withdrawal**	**Partial success**	**Success**
	5%	10%	15%	70%
Ethnic minority	9%	8%	17%	65%

Appendix 3

Glossary of terms

ECDL	European Computer Driving Licence
FE	Further Education
HE	Higher Education
HMIE	Her Majesty's Inspectorate of Education
HN	Higher National
HNC	Higher National Certificate
HND	Higher National Diploma
ICT	Information and Communications Technology
IT	Information Technology
ITPCS	IT Providers Consortium Scotland
NC	National Certificate
NQ	National Qualification
NPA	National Progression Award
PC	Personal computer
PI	Performance Indicator
SCQF	Scottish Credit and Qualifications Framework
SDS	Skills Development Scotland
SFC	Scottish Funding Council
SGA	Scottish Group Award
SIP	Skills Investment Plan
SME	Small to medium enterprise
SQA	Scottish Qualifications Authority
S3C	Scottish Colleges Computing Consortium
STEM	Science, Technology, Engineering and Mathematics
UHI	University of the Highlands and Islands
VLE	Virtual Learning Environment
WEEE	Waste Electrical and Electronic Equipment

Any enquiries regarding this publication should be sent to us at:

Education Scotland
Denholm House
Almondvale Business Park
Almondvale Way
Livingston
EH54 6GA

Tel: 01506 600 200
e-mail: enquiries@educationscotland.gov.uk

www.educationscotland.gov.uk