Pearson BTEC Nationals in Computing

Delivery Guide

Pearson BTEC Level 3 National Extended Certificate in Computing

Pearson BTEC Level 3 National Foundation Diploma in Computing

Pearson BTEC Level 3 National Extended Diploma in Computing

Pearson BTEC Level 3 National Diploma in Computer Science

Pearson BTEC Level 3 National Diploma in Computing for Creative Industries

Pearson BTEC Level 3 National Diploma in Computer Systems and Network Support

Pearson BTEC Level 3 National Diploma in Business Information Systems

First teaching 2016

Pearson BTEC Level 3 National Diploma (2017) in Computer Science

Pearson BTEC Level 3 National Certificate (2017) in Computer Science

First teaching 2017

Edexcel, BTEC and LCCI qualifications

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All information in this specification is correct at time of publication.

Welcome to your BTEC National delivery guide

This delivery guide is a companion to your BTEC Level 3 National specifications, Authorised Assignment Briefs (AABs) and Sample Assessment Materials (SAMs). It contains ideas for teaching and learning, including practical activities, realistic scenarios, ways of involving employers in delivery, ways of managing independent learning and how to approach assessments. The aim of this guide is to show how the specification content might work in practice and to inspire you to start thinking about different ways to deliver your course.

The guidance has been put together by tutors who have been close to the development of the qualifications and so understand the challenges of finding new and engaging ways to deliver a BTEC programme in the context of the new qualifications from 2016 and 2017.

Guidance around what you will need to consider as you plan the delivery of the qualification(s) has been provided. You will find information around the structure of your course, how you may wish to build the course for your learners, suggestions for how you could make contact with employers and information around the other support and resources available to you.

Unit-by-unit guidance has been provided, which includes suggestions on how to approach the learning aims and unit content, as well as ideas for interesting and varied activities. You will also find coverage of assessments, including useful advice about external assessment, as well as tips and ideas around how to plan for and deliver your assignments.

You will also find a list of carefully selected resources for each unit. The lists include suggestions for books, websites and videos that you can either direct your learners to use or that you can use as a way to complement your delivery.

We hope you will find this guidance relevant and useful.

Enjoy your course!

What's new

The BTEC Level 3 Nationals 2016 and 2017 are the result of more than three years' consultation with employers, higher education institutions (HEIs) and many thousands of tutors and managers in colleges and schools. Our aim has been to ensure that the BTEC Level 3 Nationals continue to allow a recognised and well-respected route into employment or higher education by meeting the needs of these key stakeholders and that learners continue to enjoy a stimulating course of study and develop the skills and attributes that will enable them to progress.

As a result of this consultation and on the advice of employers, higher education institutions and, most importantly, of those of you who teach BTEC, some key changes have been made to the BTEC Level 3 Nationals. These are described throughout this delivery guide and include the following.

- **Updated content and a larger proportion of mandatory content** – both employers and universities said they wanted a greater consistency in coverage of the subject for BTEC learners. Employers wanted to see systematic coverage of core knowledge and skills for their sector, and for the Nationals to reflect up-to-date industry practice.
- **The reintroduction of external assessment** – employers were keen to see an element of rigour and consistency across the country in terms of assessment, while higher education institutions wanted learners to be better prepared for meeting deadlines and preparing for formal examinations, where appropriate. Both were keen to see learners applying their knowledge and skills to new contexts through synoptic projects and assessments.

- **A focus on employability skills** – the BTEC approach to learning, through projects, practical assignments, group work and through simulating the world of work, has always supported the development of employability skills, such as self-management. In the new Nationals, the balance of cognitive and skills work has been carefully calibrated to ensure that learners get a range of different opportunities across their course.
- **Broader assessment in internal units** – the assessment criteria for each unit are carefully structured to set a clear level of demand. Distinction criteria encourage and require depth of study, including demonstration of the application of knowledge and understanding as well as a synoptic element for the learning aim or unit.
- **Alignment with DfE criteria for performance measures for 16–19 year olds in England** – all new BTECs are designed as either Applied General qualifications or Tech Levels to fulfil criteria for inclusion in 2018 performance tables and funding for 16–19 year olds and 19+ learners.

To support transition to the BTEC Level 3 Nationals 2017, we are providing an enhanced support programme with exemplar and practice materials and training. Please see the *Support and resources* section for details of this support, and the link to sign up for tutor training, which continues throughout the lifetime of the qualification.

Notes:

The specification tells you what **must** be taught and what **must** be assessed. This delivery guide provides suggestions and ideas on how you could do this.

The suggestions given in this delivery guide link with the Authorised Assignment Briefs provided by Pearson but they are not compulsory. They are designed to get you started and to spark your imagination.

Contents

OVERVIEW

Delivery Guides as support

In the specification, the 'Unit content' tells you what must be taught and the 'Assessment criteria' what must be assessed. The 'Essential information for assessment decisions' explains what the assessment criteria mean.

This delivery guide provides suggestions and ideas on how to plan and deliver the qualification, and includes a summary of recent changes.

Unit-by-unit guidance has been provided, which includes suggestions on how to approach the learning aims and unit content. Teaching, learning and formative assessment activities are also suggested. You will also find delivery plans to help you timetable your course and ensure your learners are well-prepared for internal and external assessments.

Links to carefully selected resources are provided for each unit. The lists include suggestions for books, websites and videos that will help you plan and deliver your course. Alternatively, you may wish to direct your learners to these resources.

Use the delivery guides as model templates or an interpretation on which you can base your own plan. Every delivery guide presents each unit as an exemplar, highlighting computing links to motivate tutors and learners.

Significant changes for those teaching to the new 2017 specification

The BTEC Level 3 Nationals 2017 contain significant changes to the previous 2010 version. These changes reflect the views and demands of computing teaching practitioners, those working in the computing sector and government bodies with oversight of the qualifications.

For those familiar with the older 2010 specification, these changes are summarised in the table below:

Change	New 2017		Old 2010	
Programme Name	Computing		Computing	
Qualification Names/GLH	No equivalent		Certificate	180 GLH
	Extended Certificate	360 GLH	Subsidiary Diploma	360 GLH
	Foundation Diploma	510 GLH	90 – credit Diploma	540 GLH
	Diploma in Computer Science	720 GLH	Diploma	720 GLH
	Extended Diploma	1080 GLH	Extended Diploma	1080 GLH
Mandatory Units	Between 3 and 7 dependent on qualification		Between 3 and 8, Diploma/Extended only	
Optional Units	Choose from up to 25 dependent on qualification		Choose from up to 25 dependent on qualification	
Assessment	Internal through assignment and up to 4 External depending on qualification		Internal only through assignments	

Structure

The table below shows a summary of the structure of the Computing suite of qualifications. They have been designed for post-16 learners who are seeking to continue their education through applied or technical learning, and who aim to progress to higher education, a higher apprenticeship or employment.

Unit (number and title)	Unit size (GLH)	Certificate (180 GLH)	Extended Certificate (360 GLH)	Foundation Diploma (510 GLH)	Diploma (720 GLH)	Extended Diploma (1080 GLH)	Diploma (720 GLH)			
							CC	CS	CSNS	BIS
1 Principles of Computer Science	120		M	M	M	M	M	M	M	M
2 Fundamentals of Computer Systems	90	M	M	M	M	M				
3 Planning and Management of Computing Projects	120				M	M	M	M	M	M
4 Software Design and Development Project	120					M				
5 Building Computer Systems	60						M	M	M	M
6 IT Systems Security	60						M	M	M	M
7 IT Systems Security and Encryption	90	M	M	M	M	M				
8 Business Applications of Social Media	90			M	M	M				
9 The Impact of Computing	90				M	M				
10 Human-computer Interaction	60		O	O	O	O	M	O		M
11 Digital Graphics and Animation	60		O	O	O	O	O			
12 Digital Audio	60				O	O	O			
13 Digital Video	60				O	O	O			
14 Computer Games Development	60		O	O	O	O	O			
15 Website Development	60		O	O	O	O	O	O		
16 Object-oriented Programming	60				O	O		O		

Unit (number and title)	Unit size (GLH)	Certificate (180 GLH)	Extended Certificate (360 GLH)	Foundation Diploma (510 GLH)	Diploma (720 GLH)	Extended Diploma (1080 GLH)	Diploma (720 GLH)			
							CC	CS	CSNS	BIS
17 Mobile Apps Development	60		O	O	O	O		O		
18 Relational Database Development	60				O	O		O		M
19 Computer Networking	60				O	O				
20 Managing and Supporting Systems	60		O	O	O	O			M	
21 Virtualisation	60				O	O			M	
22 Systems Analysis and Design	60		O	O	O	O	O	M		M
23 Systems Methodology	60				O	O				M
24 Software Developmet	60						M	M		
25 Web Application Development	60							O		
26 Programmable Devices and Controllers	60							O	M	
27 3D Modelling	60						O			
28 Computer Forensics	60							O	M	
29 Network Operating Systems	60								M	
30 Communication Technologies	60								M	
31 Large-scale Data Systems	60									M
32 Business Process Modelling Tools	60									M

Overview of the Computing qualification suite

BTEC Level 3 National Certificate

The Certification is equivalent in size to 0.5 of an A Level. It is made up of two units – both of which are mandatory (Units 2 and 7). The qualification is designed to be an introduction to the computing sector through applied learning and supports progression to higher education when taken as part of a programme of study that includes other vocational or general qualifications.

Unit 2 is externally assessed. This is a written examination set and marked by Pearson. First assessment is available in January and May/June 2018.

Unit 7 is an internal synoptic unit and requires learners to complete reports relating to issues with IT security and produce a plan to protect an IT system.

BTEC Level 3 National Extended Certificate

The BTEC Level 3 National Extended Certificate may be delivered as a part-time standalone course, possibly alongside other Level 3 BTECs or A-levels, for example with Maths and/or English Level 2.

There are three mandatory units for the Extended Certificate:

- Unit 1 is externally set and examined (synoptic unit)
- Unit 2 is externally set and examined
- Unit 7 is internally set and assessed.

In addition, one optional unit must be delivered and assessed.

The choice of when each unit is delivered will be determined by the mode of study – in other words, whether it is a one-year or a two-year programme.

If this is being studied as a one-year programme, it is essential for Units 1 and 2 to be delivered first to ensure that learners are ready to take assessment where relevant in the January series. There is more flexibility if this qualification is studied over two years as Year 1 would naturally lend itself to Units 1 and 2, although this would mean that all internal assessments would be pushed into Year 2. As this qualification should be taught practically, there should be ample opportunity for practical work that can be formally assessed during Year 1.

Mandatory units

Externally assessed units

Unit 1 is a mandatory, synoptic unit and it is suggested that it is delivered from the start of the course using a 'long and thin' approach, alongside other units.

Unit 2, though not synoptic, may also benefit from a 'long and thin' approach.

Assessment opportunities for Unit 1 and Unit 2 are offered in both the January and June series. First assessments are available in May/June 2017.

The 'long and thin' approach would provide centres with the opportunity to build in examination preparation time, once internally assessed units have been completed.

As Unit 1 and Unit 2 provide the underpinning knowledge for the programme, delivering these first will ensure that the learners have the right knowledge and skills needed to succeed in the internally assessed units. The key to successful examination experiences is to teach the content early, allow learners to embed their knowledge through practical work and then assess the examinations towards the end of the programme.

Internally assessed units

Unit 7 is a mandatory, internally assessed unit. It would probably be a good idea to deliver this unit 'short and fat' in the Autumn/Spring term. This would help to ensure that the assignments are available for standards verification in a timely manner.

Optional units

Learners must choose one optional, internally assessed unit from Units 10, 11, 14, 15, 17, 20 and 22.

It would probably be best to deliver the internally assessed units short and fat in the Autumn/Spring term. This would help to ensure that the assignments are available for standards verification in a timely manner. The benefit to learners of a short and fat delivery is the opportunity to immerse themselves fully in the unit.

BTEC Level 3 National Foundation Diploma

The BTEC Level 3 National Foundation Diploma is designed as a one-year, full-time course or as part of a two-year, full-time programme with opportunity for inclusion of other BTEC National Level 3 courses or A-levels. It consists of four mandatory and two optional units.

The four mandatory units for the Foundation Diploma are:

- Unit 1 – externally set and examined
- Unit 2 – externally set and examined
- Unit 7 – internally set and assessed
- Unit 8 – internally set and assessed.

In addition, two optional units must be delivered and assessed.

The likely use of this programme would be as a one-year programme, with a view to topping up to the Extended Diploma in year 2, or completing with no top-up in mind. Therefore, this would suggest a 'semester-based' approach, with Units 1 and 2 taught first to ensure that learners are ready for the external assessments, alongside Unit 8 to enable learners to build their technical knowledge before attempting Unit 7, or the designated optional units in Semester 2.

Mandatory units

Externally assessed units

Unit 1 is a mandatory, synoptic unit and it is suggested that it is delivered from the start of the course using a 'long and thin' approach, alongside other units.

Unit 2, though not synoptic, may also benefit from a 'long and thin' approach.

Assessment opportunities for Unit 1 and Unit 2 are offered in both the January and June series. First assessments are available in May/June 2017.

The 'long and thin' approach would provide centres with the opportunity to build in examination preparation time, once internally assessed units have been completed.

Internally assessed units

Units 7 and 8 are mandatory and internally assessed units. It would probably be a good idea to deliver the mandatory internally assessed units short and fat in the Autumn/Spring term. This would help to ensure that the assignments are available for standards verification in a timely manner.

Optional units

Learners are to choose two optional units from Units 10, 11, 14, 15, 17, 20 and 22. It would probably be best to deliver these optional units short and fat in the Autumn/Spring term if learners are following a one-year course. This would help to ensure that the assignments are available for standards verification in a timely manner. However, learners on a two-year course may benefit from delivery of these units in the summer term.

BTEC Level 3 National Extended Diploma

The BTEC Level 3 National Extended Diploma is likely to be delivered full time, over two years, possibly alongside another BTEC National (Certificate/Extended Certificate) in a different subject or an A-level in a complementary or contrasting subject.

There are seven mandatory units for the Extended Diploma:

- Unit 1 is externally set and examined
- Unit 2 is externally set and examined
- Unit 3 is externally set and examined
- Unit 4 is externally set and examined
- Unit 7 is internally set and assessed
- Unit 8 is internally set and assessed
- Unit 9 is internally set and assessed.

In addition, six optional units must be delivered and assessed.

This qualification is the more traditional route for BTEC Computing learners and is more beneficial if studied over two years.

In this instance, Units 1 and 2 should still be delivered first and therefore will probably be delivered short and fat. Units 3 and 4 (Unit 4 is a synoptic unit) could be delivered in the same way in the latter part of the second year. The remaining units can be delivered in any order to suit the teaching team and the flow of learning.

Centres should ensure that internally assessed units are complete by mid-May to enable work to be available for standards verification. This would mean that revision in anticipation of examinations could then complete the activity for the year.

Mandatory units

Externally assessed units

Unit 1 is a mandatory, synoptic unit and it is suggested that it is delivered from the start of the course using a 'long and thin' approach, alongside other units with assessment scheduled for the June series in the first year.

Unit 2, though not synoptic, may also benefit from a 'long and thin' approach in the first year of teaching.

Assessment opportunities for Unit 1 and Unit 2 are offered in both the January and June series. First assessments are available in May/June 2017.

Unit 3, though not synoptic, may also benefit from a 'long and thin' approach in the second year of teaching.

Unit 4 is a mandatory, synoptic unit and it is suggested that it is delivered from the start of year 2 using a 'long and thin' approach, alongside other units with assessment scheduled for the June series in the final year. Assessment is available in Dec/Jan and May/June, with the first assessment in May/June 2018.

The 'long and thin' approach to teaching the mandatory externally assessed units would provide centres with the opportunity to build in examination preparation time, once internally assessed units have been completed. This is particularly important for the synoptic units where tutors may wish to draw upon learning from internally assessed units.

Internally assessed units

Unit 7, 8 and 9 are mandatory, internally assessed units.

It would probably be best to deliver the mandatory internally assessed units 'short and fat' in the Autumn/Spring term of the first year of teaching. This would help ensure that the assignments are available for standards verification in a timely manner.

While not synoptic, delivery in the first year may help learners with their selection of optional units.

Optional units

Learners must choose six optional units from Units 10–23.

The majority of these units will probably need to be delivered in year 2 but should be completed by mid-May in time for standards verification. However, centres may prefer to introduce at least one optional unit into year 1 to give learners the opportunity to follow individual interests.

Whether they are delivered 'short and fat' or 'long and thin' will depend on the units selected and tutor availability.

BTEC Level 3 National Diploma in Computing

This qualification is designed to support learners who want a two-year, full-time course that meets entry requirements of a course in computer-related study at higher education.

There are six mandatory units (three of which are external) and two optional units. Optional units can be chosen from Units 10–23. Units 1, 2, 3, 7, 8 and 9 are mandatory.

BTEC Level 3 National Diploma in Computer Science and specialist programmes

The BTEC Level 3 National Diploma has a Computer Science general route and three specialist pathways available within the programme and the optional units are grouped accordingly (see table below).

- **Computer Science:** six mandatory units – two externally set and assessed, and four optional units.
- **Computing for Creative Industries:** six mandatory units – two externally set and assessed, and four optional units.
- **Computer Systems and Network Support:** ten mandatory units – two externally set and assessed.
- **Business Information Systems:** ten mandatory units – two externally set and assessed.

The following table shows the units available for these qualifications:

M – Mandatory

O – Optional

Ten units from:	Computer Science	Computing for Creative Industries	Computer Systems and Network Support	Business Information Systems
1: Principles of Computer Science (External)	M Synoptic	M Synoptic	M Synoptic	M Synoptic
3: Planning and Management of Computing Projects (External)	M	M	M	M
5: Building Computer Systems	M	M	M	M
6: IT Systems Security	M	M	M	M
10: Human–Computer Interaction	O	M Synoptic		M
11: Digital Graphics and Animation		O		
12: Digital Audio		O		
13: Digital Video		O		

14: Computer Games Development		O		
15: Website Development	O	O		
16: Object-oriented Programming	O			
17: Mobile Apps Development	O			
18: Relational Database Development	O			M
20: Managing and Supporting Systems			M Synoptic	
21: Virtualisation			M	
22: Systems Analysis and Design	M	O		M
23: Systems Methodology				M
24: Software Development	M Synoptic	M		
25: Web Application Development	O			
26: Programmable Devices and Controllers	O		M	
27: 3D Modelling		O		
28: Computer Forensics	O		M	
29: Network Operating Systems			M	
30: Communication Technologies			M	
31: Large-scale Data Systems				M Synoptic
32: Business Process Modelling Tools				M

Assessment

One of the key factors in the development of this BTEC Computing suite was to ensure that confidence in the suite was maintained and endorsement from both higher education institutions and employers is a reflection of the confidence that stakeholders have in these qualifications. This is supported by the continued allocation of UCAS points.

The introduction of external assessment is a positive step in improving quality as well as the learner experience. This is particularly true in the Computing sector as learners who choose to work in this sector may well continue to study for professional qualifications that lead to vendor certification and where examinations or other forms of external assessment are the norm.

In addition, the formalisation of synoptic assessment (which has been in evidence in many centres as good practice for years) sees an end to units being taught in isolation. Learners will be able to see the connections between prior and current learning, drawing on all their developed knowledge and skills to solve Computing problems.

There are three main forms of assessment in the BTEC Level 3 National Computing qualifications.

External assessment

- **Written examination** – the written examination is set and marked externally. Centres will need to ensure that learners are entered for these examinations as there are potentially up to two windows of opportunity per year and Pearson is unable to predict when your learners will be ready. That said, there are distinct benefits to undertaking the external assessments later in the course once learners have had an opportunity to use their theoretical learning in the practical work in internally assessed units.
- **Set task** – this task is set and marked externally. Centres will need to ensure that learners are entered in line with windows of opportunity. The latest timetables should always be referred to, which can be found here: http://qualifications.pearson.com/en/support/support-topics/exams/exam- timetables.html

Internal assessment

- **Assignment** – the assignment method is set and marked internally. This method is familiar to all BTEC tutors and continues to be the focus of activity with the opportunity to link assessments to employers and working practices as has always been the case.

Synoptic

- **Synoptic units** – although synopticity has essentially been at the core of BTEC delivery and assessment since its creation, there is now a more formal approach to evidencing synopticity with units designed to enable synoptic assessment to take place through a variety of assessment methods. In delivering the synoptic units, you should ensure that learners are able to apply knowledge and understanding from a variety of units to their completion of the assessment.

Making the right choice for your learners

The suite of qualifications is intended to be inclusive and support individuals in their progression. The prior achievement and aspirations of learners are key to advising the most appropriate study programme. This would ideally combine in-depth discussion with a portfolio and qualification review.

For learners who wish to progress directly to higher education, there is a range of qualifications in the suite that ensures that they will have the skills to cope with the academic and independent learning.

Below are some examples of learners' potential progression routes, though it must be remembered that Pearson require no prior achievements to complete a specification and that entry requirements are at a centre's discretion.

16-year-old learner choice		
Progression intention	**Prior achievement**	**Potential BTEC National route**
Computing subject in HE	5 GCSEs C or above or BTEC Level 2 First Diploma ICT with GCSE C or above in Maths and English	Any of the qualifications in the Computing suite, ensuring that the combination provides enough UCAS points to access HE programmes (Learners should also check the requirements from their university of choice as to whether an additional Maths qualification at Level 3 is needed.)
Computing subject in HE, but uncertain whether staying in sector	5 GCSEs C or above or BTEC Level 2 First Diploma ICT with GCSE C or above in Maths and English	Year 1: BTEC National Foundation Diploma in Computing Year 2: If firming up for computer sector, then continue into Extended Diploma. If moving away from sector, a second Foundation Diploma in another specialism. This enables learners to keep their options open.
HE, but uncertain of course	5 GCSEs C or above or BTEC Level 2 First Diploma ICT with GCSE C or above in Maths and English	BTEC Extended Certificate in Computing with A-levels or other Applied General qualifications
Entry level employment or apprenticeship	5 GCSEs C or above or BTEC Level 2 First Diploma ICT with GCSE C or above in Maths and English	BTEC Level 3 National Diploma in Computer Science/Computing for Creative Industries/Computer Systems and Network Support/Business Information Systems

19+ Learner choice		
Progression	**Prior achievement**	**Potential BTEC National route**
Computing subject in HE	No experience in Computing, but with 5 GCSEs C or above including Maths and English	BTEC Level 3 Extended Diploma in Computing (Learners should also check the requirements from their university of choice as to whether an additional Maths qualification at Level 3 is needed.)
Entry level employment or apprenticeship	No experience in Computing, but with 5 GCSEs C or above including Maths and English	BTEC Level 3 National Diploma in Computer Science/Computing for Creative Industries/Computer Systems and Network Support/Business Information Systems with appropriate vendor certification

Making contact with employers

Employer contact is one of the most cherished experiences BTEC National learners can have, by ensuring realistic and valuable learning.

While you may have your own contacts at centre level, you may be able to source additional employers through the wide variety of IT and Computing trade association membership bodies.

Any organisation identified with an * has an open list of members included on their website.

UKITA*	http://www.ukita.co.uk/
ITSMF	http://www.itsmf.co.uk/
TechUK*	https://www.techuk.org/
Manchester Digital*	https://www.manchesterdigital.com/
Digital Birmingham	http://digitalbirmingham.co.uk/
Digital Union*	http://digiunion.co.uk
British Computer Society	www.bcs.org
CREST*	http://crest-approved.org/
The Tech Partnership*	https://www.thetechpartnership.com/ For a list of employers who have signed up to the Partnership, see here: https://www.thetechpartnership.com/about/the- partnership/employers/
Institution of Analysts and Programmers	http://www.iap.org.uk/main/
Women in Technology	http://www.womenintechnology.co.uk/
UKWDA (UK Web Design Association)	http://www.ukwda.org/ For a list of employers who are premium members, see here: http://www.ukwda.org/premium-members
The Institute of Engineering and Technology	http://www.theiet.org/
National Computing Centre	http://www.ncc.co.uk/

In addition, there are a number of large employers who also have an education function. These provide a range of services including ideas on improving the effectiveness of learning and case studies. These include the following:

Barclays – Barclays Code Playground, introducing Digital Eagles (coding experts working with young people)	http://www.barclays.co.uk/DigitalEagles/Barclays CodePlayground/P1242686640999
Microsoft – Edupreneurship collaboration	https://education.microsoft.com/
Oracle – Introducing the Oracle Education Foundation	https://www.oraclefoundation.org/
IBM	http://www-935.ibm.com/industries/education/
Cisco – The Cisco Networking Academy	https://www.netacad.com/
Coca Cola – The Real Experience – Real Business Challenge and Real Education Centres	http://www.therealexperience.co.uk/
Toshiba – Ambassadors Programme	http://www.toshiba.co.uk/generic/education-workshops/

There are currently 39 LEPs (Local Enterprise Partnerships) in the UK. These voluntary partnerships between employers and local authorities were set up in 2011 by the Government's Department for Business, Innovation and Skills (usually called BIS) to identify local opportunities for economic growth and jobs. Find your local LEP through the following link: http://www.lepnetwork.net/about-leps/

Many of the IT vendors also have education services including the following – this is in addition to organisations such as Microsoft, Oracle and Cisco listed above:

CompTIA	https://www.comptia.org/
Axelos	https://www.axelos.com/
LPI (Linux Professional Institute)	https://www.lpi.org/
VMWare	http://www.vmware.com/uk
Voluntary clubs and other organisations:	
Code Club	https://www.codeclub.org.uk/
Technokids	http://www.technokids.co.uk/
TechFutureGirls	https://www.techfuturegirls.com/
BetaPlus	http://betaplus.org.uk/index.php
Teentech	www.teentech.com
CoderDojo	https://coderdojo.com/
The Pixel Gang	http://www.thepixelgang.co.uk/

You should also consider making links with local universities that will also have links to employers.

Employability skills

Employers not only look for technical skills, but also employability skills. These include:

- **Self-management:** readiness to accept responsibility, flexibility, time management, readiness to improve own performance.
- **Teamworking:** respecting others, cooperating, negotiating/persuading, contributing to discussions.
- **Business and customer awareness:** basic understanding of the key drivers for business success and the need to provide customer satisfaction.
- **Problem solving:** ability to analyse facts and circumstances and applying creative thinking to develop appropriate solutions.
- **Communication and literacy:** application of literacy, ability to produce clear, structured written work and oral literacy (including listening and questioning).
- **Application of numeracy:** manipulation of numbers, general mathematical awareness and its application in practical contexts.
- **Application of information technology:** basic IT skills including familiarity with word processing, spreadsheets, file management and use of internet search engines.

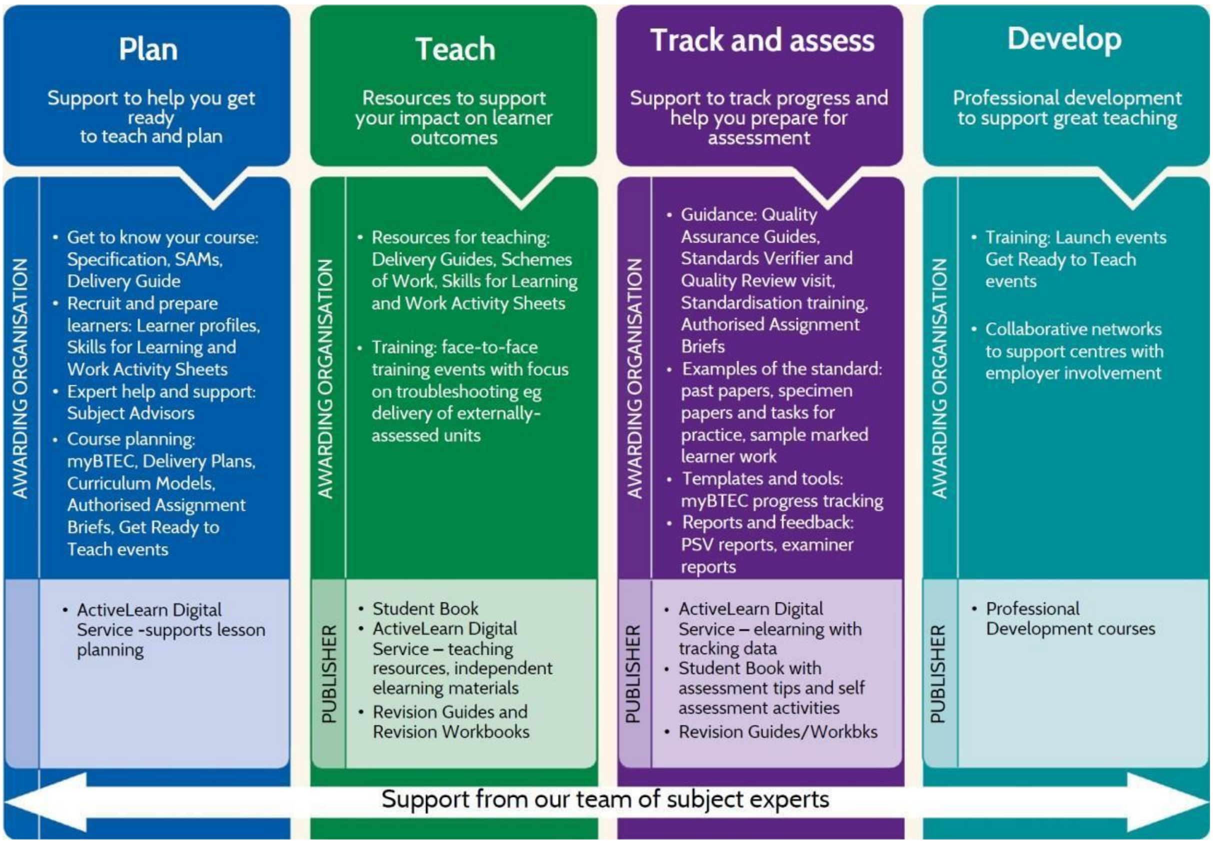
SUPPORT AND RESOURCES

There are a wealth of resources available to ensure that you feel confident delivering your BTEC National qualification throughout your entire course.

All the 'Awarding Organisation' resources can be found on the Pearson Qualifications website here:

http://qualifications.pearson.com/en/qualifications/btec-nationals/computing-2016.html

As well as the free resources supporting the qualification, provided by Pearson as an Awarding Organisation, Pearson Learning Services ('Publisher' in the tables below) provides a range of engaging resources to support BTEC Level 3 Nationals. See breakdown of resources available (by format) in the diagram below.



In addition to the 'publisher' resources listed above, publishers other than Pearson may produce textbooks that are endorsed for BTEC. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

There are also a number of people who are available for you to speak to:

- **Standards Verifiers** – they are subject specialists who can support you with ensuring that your assessment plan is fit for purpose and whose role is to confirm that you are assessing your learners to national standards as outlined in the specification by providing quality assurance through sampling.
- **Curriculum Development Managers (CDMs)** – they are regionally based and have a full overview of the BTEC qualifications and of the support and resources that Pearson provides. CDMs often run network events.
- **Customer Services** – the 'Support for You' section of our website gives the different ways in which you can contact us for general queries. For specific queries, our service operators can direct you to the relevant person or department.

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Training for the new BTEC Level 3 Nationals can be found on the Pearson website: http://qualifications.pearson.com/en/support/training-from-pearson-uk.html

UNIT 1: PRINCIPLES OF COMPUTER SCIENCE

Delivery guidance

Approaching the unit

This unit allows your learners to explore the ways in which the features of computer programming can be applied to solve problems. The focus should be on learners understanding how to deconstruct problems and develop a sound understanding of programming concepts. Learners will need to be able to plan solutions using pseudocode and flow charts, as well as develop the quality and functionality of given pseudocode or flow charts through applying common programming structures. They will also need to analyse how data is handled within a computer system, and how different programming paradigms can be applied.

There are many ways to solve problems and you should expose your learners to a wide range of examples of effective and less effective programming solutions. They should be able to interpret, use, debug and suggest improvements to code that has been given to them in any of the four programming and mark-up languages listed in the specification.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

In the external assessment, learners may be tested on any of the content in the specification. Learners must practise the correct and full completion of any templates given in sample assessment materials (SAMs) or past papers in preparation for their external assessment task.

Delivering the topics

For topic A, you could start by exploring the concepts of computational thinking. This could be done through class and small group discussions about how these concepts are applied to the process of problem-solving and computer programming. Small group activities could examine how to apply computational thinking skills to a given concept or problem. After your initial explanation of the skills and processes, learners could be given a simple/common computer game and asked to explore how computational thinking might apply to it.

You should only spend a short amount of classroom time introducing and explicitly teaching computational thinking as the emphasis should be very much on hands-on practical activities through which learners develop skills by experimentation and regular practice. Learners will practice applying computational thinking on numerous occasions while completing this qualification. This will also be a useful skill for them in further study or employment in the computing industry.

For topic B, learners would benefit from exposure to a wide range of different problems and scenarios for which they must write sections of pseudocode to describe the computing processes required. It would benefit them to start with simple one- or two-line processes and individual logical concepts, and steadily build up the complexity of the solutions that learners are expected to develop. For example, to develop your learners' understanding of IF statements, you may ask them to write standalone IF statements to describe given conditions in a range of contexts, before they apply them to a larger structure.

Learners should be able to use pseudocode and flow charts to demonstrate their ability to develop computer programming solutions and to present the logic and structure in a way that could be implemented in an appropriate programming language. Give learners the opportunity to explore, evaluate and develop given pseudocode and flow charts in addition to the time that they spend independently developing a solution to a given problem. Pseudocode should be language-agnostic (independent of any programming language), and learners should use it to demonstrate their understanding of accepted computing concepts, eg consistent use of variable names, assignment of data types and sensible logical structures. Learners should present their flow charts using standard British Computer Society (BCS) symbols.

For topic C, give learners the opportunity to explore and apply standard programming structures and conventions in a range of contexts. Learners must demonstrate an understanding of common functions and data-handling processes. They also need to be able to apply logical and mathematical concepts and make use of common built-in functions of programming languages, validation techniques, and standard algorithms to solve problems. Learners should be able to apply these skills and techniques to given scenarios.

It would be beneficial for learners to explore, use and develop the content for this topic in a range of contexts. They should apply these effectively when writing pseudocode and explore their use in the given programming and mark-up languages. Learners will not be expected to write large sections of computer code from scratch, but they should be able to identify and analyse the use of sections of code, suggesting improvements and changes as appropriate. You should supply opportunities for learners to explore good and not-so-good examples of the structures and processes, identified both as pseudocode and as computer-based code. When exploring code, give learners the opportunity to explore examples in hard copy (as would be expected in the exam) and also within a coding or development environment. This will allow them to see the outcomes of effective and less effective programming techniques, as well as the effect of changes.

For topic D, learners should explore different programming paradigms and how they are used to solve a range of problems. When delivering this content, you could start with activities that focus on what a particular paradigm is used for, using the given languages as a context. Ensure that learners understand the concepts and principles behind each particular paradigm and language. After exploring the uses and implications of a particular language, start to expose learners to actual code that follows a specific paradigm. Learners should be given the opportunity to explore, change and develop the given code in order to see the effects of effective and less effective code.

Exploring code within each paradigm will also allow learners to develop their understanding of concepts studied in earlier topics. Where possible, highlight these connections to support learners' progression. As learners are exposed to additional paradigms, you could give them follow-up activities, such as asking learners to consider how a given piece of code in one language might be translated into another and the implications of implementing the code in a different language. Learners should also be able to communicate their understanding of what a given piece of code would do (within a specific context), including how data would be processed by the program, the efficiencies and inefficiencies in the program, and ways in which the code could be improved.

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High quality, accurate verbal and written communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

Assessment guidance

Learners will be assessed by a written examination paper, including short-answer questions, extended tasks and tasks requiring diagrammatical explanations and solutions. This will assess both their computational thinking skills and their understanding of the principles of computer science.

In preparation for the examination, learners should develop solutions to given problems using pseudocode and flow charts. They should be able to analyse and evaluate the efficiency of given solutions in the form of pseudocode, flow charts and code, as well as able to explore the implications of different solutions in given contexts. The practical application of these skills should be supported by the development of exam techniques, such as how to identify the requirements of specific command words and how to structure and present answers.

The examination will be presented as an examination paper and will be supported by an information booklet containing guidance on unusual or non-standard pseudocode, code functions, etc, that have been used in the examples. The booklet may also contain additional materials such as code extracts and planning documents that will be required to answer the questions.

For full details of assessment, refer to the SAMs and the specification.

Getting started

This gives you a starting place for one way of delivering the unit. Activities are suggested in preparation for the external assessment.

Unit 1: Principles of Computer Science

Introduction

Within any area of the computing industry, people will need to be able to identify aspects of a problem, analyse the needs of a user and/or client, and supply a suitable solution that meets the identified needs. This unit should give learners a solid understanding of the key principles of computer programming and equip them with the skills and knowledge required to deconstruct problems and develop effective computing solutions. These transferable skills will equip learners for further study or employment in the computing industry.

Topic A – Computational thinking

- You could begin by introducing the aim of the unit (ie the basic principles of computer programming and problem-solving) and how the concepts of computational thinking can be applied to practical problems.
- Explain to learners that computational thinking can be thought about in terms of four 'stages': decomposition, pattern recognition, pattern generalisation and abstraction, and algorithm design.
- Learners could work in small groups to look at an example of a program (such as a simple computer game) and identify how each of the four 'stages' of computational thinking may be applied. For example:
    - for 'decomposition', learners might be expected to explain the stages of the game, the win scenario, the role of a particular character in the game etc
    - for 'pattern recognition', they may identify that certain non-playable characters move in the same way
    - for 'pattern generalisation and abstraction', they could identify the required variables or start defining the required inputs
    - for 'algorithm design', they could describe parts of the game, such as what happens when a playable character makes contact with a certain item, in order to plan the logical steps needed in readiness for writing code.
- Learners should understand that computational thinking is not specific knowledge to be recalled but a set of skills and a way of working that can be applied to aspects of this and other units.
- Give learners the opportunity to explore a range of problems to which they can apply their computational thinking skills. However, after an initial introduction and some individual and group activities that apply to specific examples, learners should continue to develop these skills while working on the subsequent topics in this unit.
- Examples that learners could be given to work with include:
    - the invoice problem – applying different discounts to different products and then applying VAT to only part of an invoice because some goods are zero-rated
    - the commercial greenhouse where the environment is computer controlled.

Topic B – Standard methods and techniques used to develop algorithms

This topic is designed to allow learners to start to develop an understanding of the need for logical structures within computer programs. Ensure that they have plenty of opportunities to explore how these structures can be applied to solve problems.

- The introduction to this topic should connect logically to the previous topic. For example, you could introduce pseudocode as a natural development of 'algorithm design' covered in the previous topic.
- To develop learners' understanding, it may be beneficial for them to start by looking at the sequencing of instructions, as this will allow them to explore the importance of identifying the correct order in which tasks should be carried out. Learners could work on this individually, or in small groups, to look at given problems. You could also give them examples of solutions that do not always give tasks in the correct order, as this would allow them to identify the problem with the proposed solution and consider its potential impact.
- Give learners pseudocode that has instructions in the wrong order, for example VAT calculated on an invoice total rather than parts of an invoice, or invoice lines because some of the items are zero-rated in terms of VAT.

  This particular problem is not only about the sequence of instructions, but also about understanding the nature of the problem.
- Learners should then explore the logical structures that can be used to describe computer processes such as IF statements and loops (see the specification for a full list of processes). You could give learners sample code and ask them to explain what the statements in the code do. They should then move on to using pseudocode to describe identified processes before deconstructing a problem and describing a solution with pseudocode.

  There are many examples that could be given here including:

  - the environmental controls in the commercial green house will all be activated based on sensor readings and decisions made such as humidity, temperature, feeding cycles, watering cycles (both scheduled and responsive).

  The example above could be distributed to smaller groups in the class, each taking part of the problem.
- Depending on your learners' previous experience with computer programming, you may wish to limit initial pseudocode writing tasks to a few lines describing a single process or action. You can increase the length and complexity of the tasks as learners' skills develop.
- Vary the level of scaffolding you give for the devised tasks. Sometimes you may wish to give learners a large amount of pseudocode, which they may have to evaluate and debug. At other times, you may wish to give them a scenario and some success criteria for which they must devise an algorithm. This will help learners to develop the ability to apply their skills in context.
- Learners must be able to use and understand flow charts that make use of standard British Computer Society (BCS) symbols. As with pseudocode, learners must be able to interpret and evaluate solutions presented in the form of flow charts, as well as to present their own ideas using the correct symbols and structures.
- Explain that pseudocode should be language-agnostic. Learners will use it as a vehicle to demonstrate their understanding of accepted computing concepts, eg order of instructions, use of naming conventions for variables and efficient structures.

Topic C – Programming paradigms
This topic gives you a natural link between topic B and topic D. It gives learners the opportunity to explore the concepts and ideas that are common to many programming languages. • You will have mentioned some of the concepts in this topic during the previous topic – for example, basic arithmetic operations would have been used when writing pseudocode algorithms. Therefore, some of the concepts in this unit could be introduced by revisiting a scenario and algorithm (or sets of algorithms) previously developed. You could then set activities based on these previous scenarios. These activities should allow learners to consider concepts that may not have been introduced before, such as considering the data types to be used. This would also allow learners to explore the reasons why particular data types might be used and how they affect the development of program and its functionality. For example, one of the key issues with data types is that there pre-written functions and methods in most languages that provide common basic actions linked to an object's data type. Consider the string data type: o finding the length of a string o placing all characters in upper or lower case (because an upper case 'A' is not the same as a lower case 'a' as they have different ASCII codes o reversing a string o comparing strings. These functions and methods only work on objects that are strings. • Revisiting algorithms will give you further opportunities to introduce new programming concepts. If learners have already been asked to develop a number of algorithms in pseudocode (for example, for a fitness-tracking mobile app), use this example to build upon their skills. In this example, the developed algorithms may describe the processes of calculating body mass index (BMI), calculating kilocalories burned and adding together the number of kilocalories used over a given period. Ask learners to consider how they could integrate these algorithms into a larger program and to consider the impact that the algorithms in their current form would have on a larger program. This would allow you to explore factors such as modularity, global versus local variables and the ways in which values can be passed from one 'sub-routine' to another. • Introduce the concept of large scale business systems development. For example, developing a CRM system for a business, which could be implemented using a phased strategy (by functional business area, adding new functionality once developed functionality is confirmed as working). Cover how risks could be mitigated, such as running old and new systems in parallel for a period of time (which creates more work but gives business continuity if the new system fails). • Learners should also understand that they should create functions for actions they cannot find in libraries but might reuse - for example a validation routine to validate a number in a range. The parameters passed in would include the upper and lower limit for the number, plus the number itself, and the function would output a Boolean indicating the number is or is not valid. • In this topic, learners are likely to work mostly with pseudocode as a way of exploring the concepts without the additional demand of learning the syntax of a particular language. As learners start to understand the concepts covered in the topic, you could start to show them how you would execute these concepts within a programming environment, using one of the programming languages covered in topic D. Python 3.4 (or subsequent version) would give a good starting point for many learners as its structure gives them a natural link between pseudocode and

programming. Python also allows users to execute very small amounts of code.

- Learners must know how a number of common algorithms work, as well as why and how to use them. You could give examples of these standard algorithms and, as learners develop their understanding, you should start to expect them to apply these algorithms in their own solutions.
- Throughout this topic, you should expose learners to a wide range of scenarios, giving varying levels of support as they complete the given tasks. These scenarios should reflect the types of tasks that may appear in the examination.

  Typical tasks that help to develop programming skills include:
  - the cash point
  - conversion programs
  - displaying multiplication tables
  - guessing games
  - sorting algorithms.

Topic D – Types of programming and mark-up language

By the end of this topic, learners will need to understand the features, applications and implications of four different languages: C family, Visual Basic, HTML5 (or subsequent version) and Python 3.4 (or subsequent version).

- When delivering this topic, you may wish to start with activities that focus on why a particular language may be used and the concepts and principles behind using it to create programs and other digital content.
- After exploring the uses of one particular language and the implications of the choice of language, expose learners to actual code that follows a specific paradigm. Give learners the opportunity to explore, change and develop the given code in order to see the results of effective (and not so effective) code.
- If you used a particular programming language as an example in topic C, you may want to choose this in order to give learners an easy transition between the two topics. Ensure that learners have a solid understanding of each language before moving on to the next. Learners will not have to write large sections of code from scratch, but they will need a working knowledge of each of the four language families listed in the specification, so that they can analyse, evaluate, debug and develop given code in the examination.
- Give learners the opportunity to experiment with code within each paradigm, allowing them to make changes and additions to see how the code works. This will develop learners' understanding of the concepts studied in the earlier topics.
- You could give learners follow-up activities, such as asking them to compare how a given piece of code in one programming language might be translated into another and the subsequent implications of implementing the code in a different language. Learners should also be able to communicate their understanding of what a given piece of code would do within a given scenario. They should consider how the program would process data, efficiencies and inefficiencies in the program, and ways in which the code could be improved.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3: Planning and Management of Computer Projects*
- *Unit 4: Software Design and Development Project*
- *Unit 9: The Impact of Computing*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.python.org/
  Python - an open-source programming language. The website contains downloads for various operating systems and official documentation
- www.w3schools.com/html/default.asp
  W3Schools – offers tutorials in web development languages, including HTML (with sections on HTML5), covering basic and more complex features.
- https://msdn.microsoft.com/en-us/library/2x7h1hfk.aspx
  Microsoft® Developer Network – guidance for using Visual Basic®, including language walkthroughs.
- www.microsoftvirtualacademy.com/en-us/training-courses/vb-fundamentals-for-absolute-beginners-8297
  Microsoft Virtual Academy – a series of introductory tutorial videos on using Visual Basic.

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UNIT 2: FUNDAMENTALS OF COMPUTER SYSTEMS

Delivery guidance

Approaching the unit

This synoptic unit allows learners to explore how computer systems and their component parts work. Learners will need to understand how hardware and software combine to make a system that can, in turn, form part of a larger system. Learners will need understand how data is represented in digital form and how it is used, stored, processed and transmitted by different parts of a system within vocational contexts. They will also need to be able to analyse the impact of computer systems, evaluate the effectiveness of systems in a range of vocational contexts and, where appropriate, suggest improvements and make justified recommendations.

You should prepare learners to be highly effective and technically fluent users of computer systems. Learners should have both theoretical and practical experience of how to use and combine components and systems to meet vocational needs. Learners should be able to create and interpret systems diagrams and flow charts to plan and/or describe computer systems and associated processes.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

In the external assessment, learners may be tested on any of the content in the specification. Learners must practise the correct and full completion of any templates given in sample assessment materials (SAMs) or past papers in preparation for their external assessment task.

Delivering the topics

For topic A, learners should have an understanding of how individual internal computer components and larger hardware devices can be used individually or in combination with other computer systems. Learners should have a sound understanding of how the features of different hardware devices affect their use in an IT system, as well as the implications of the relationship(s) between components, devices and relevant peripherals.

Learners should be aware of the important role that software plays in any system and should understand the roles and functions of different types of software. Learners should be able to analyse how software and hardware make use of data to achieve identified aims and be able to analyse the impact of these on the overall effectiveness of a computer system and the associated implications for individuals and organisations.

For topic B, learners should understand the principles and implications of different computer system architecture and microarchitecture models. Learners should have a strong grasp of the purpose and functions of component parts within microarchitecture models, the factors that affect the performance of individual and related components, and the resulting implications for systems, individuals and organisations.

For topic C, learners should understand the concept of how data can be represented and stored in digital format. Learners should be able to use and interpret number systems that are used in computer systems to process numerical data and should also be able to perform operations and calculations of data in these forms. Learners should understand the purpose of systems used for representing text in digital form and the associated processes and implications.

Learners should explore how images are captured, represented and stored in digital form. You should give learners opportunities to explore the features of digital images (including colour modes, bit depth and resolutions), and opportunities to investigate how variations in hardware, software and computer processes affect the stored data, and the resulting impact on the quality and accuracy of an image.

For topic D, learners should explore the use of data structures within computer systems. Learners should have a strong grasp of how data is stored within these structures and how these structures affect how a computer system can access and use the data. Learners should be confident in using and exploring matrix representation in computer systems and should be able to perform and interpret processes and calculations using matrices and arrays.

For topic E, learners should explore the ways in which data is transmitted within and between computer systems. Learners should explore the technologies that enable devices and systems to communicate and share data with each other and how the features and characteristics of these technologies affect the system and its effectiveness. Learners should be aware of different connection types and the processes used to transmit data using these connection methods.

Learners should have a strong grasp of the role and implications of protocols used to govern data transmission and issues that relate to using technologies for transmitting data. Learners should be able to describe, apply and justify the use of encryption methods and their role in protecting data. Learners should explore the use and effects of compression on data and have a good understanding of its use by computer systems.

You should give learners opportunities to investigate and apply common techniques and processes for checking and correcting errors in transmitted data. Learners should be able to analyse the uses and implications of error detection and correction systems.

For topic F, learners should be able to use, apply and interpret the use of Boolean logic to identify and analyse the logical structures and computer processes of a computer system. You should supply learners with opportunities to explore the use and interpretation of system diagrams and flow charts to represent systems and processes. This topic is best taught in conjunction with other topics.

You should ensure that learners have opportunities to apply their understanding of all topic areas in vocational contexts and you should help learners to create logical links between different areas of the specification. Learners should be able to recall factual knowledge about computer systems, analyse situations, evaluate decisions and discuss wider considerations of the implementation and use of computer systems. You should deliver content for all topics through a combination of presentations, individual and group learning tasks, visits, guest speakers and detailed case studies.

Assessment guidance

Learners will be assessed by a written examination paper, which will include short-answer questions, extended tasks and tasks requiring diagrammatical responses. This will assess learners' technical and theoretical understanding as well as their analytical skills.

In preparation for the examination, learners should respond to vocational scenarios to explore the use of computer systems and associated hardware and software. Learners should be able to discuss, analyse and evaluate small- and large-scale computer systems. Learners will need to back up these skills by developing their exam techniques, such as how to identify what specific command words require and how to structure and present answers.

For full details of assessment, refer to the SAMs and the specification.

Getting started

**This gives you a starting place for one way of delivering the unit.
Activities are suggested in preparation for the external assessment.**

Unit 2: Fundamentals of Computer Systems
Introduction Computer systems are present in almost everything people do. They help support and enable individuals and organisations to achieve their aims. Understanding how the component parts of a system achieve their aims, and the effect that each part has on the whole system, is a valuable skill in all areas of the computing industry and in other vocational areas. This unit should equip learners with strong technical knowledge of how computer systems are formed and how they are implemented in a range of contexts. Learners should be able to apply in-depth technical knowledge when considering the wider implications of computer systems. These transferable skills will equip learners for further study or employment in a range of vocational areas.
Topic A – Hardware and software
• You should emphasise context when delivering this unit, both in terms of the setting in which systems are used and in terms of the types of activity technical staff will engage in when supporting hardware and software. • You could begin by introducing the aim of the unit: ie to become a highly skilled, technically fluent user of computer systems. You could then go on to explain how understanding computer systems, including their possibilities and limitations, can be applied to plan systems, and to analyse and evaluate outcomes or decisions in many different situations. • Introduce learners to the concept that a computer system can be anything from a single digital device to a global collection of computers. Explain that even large IT systems are made up of smaller devices that can perform both an isolated individual role or be part of a larger system. • It might be useful to establish a baseline understanding of learner concepts of digital devices. You should start with common devices, such as computers and mobile devices, before moving to more specialised or less common devices. You could introduce components and devices, along with an overview of the tasks that they can perform, to give the learners examples in context. Learners should explore the capabilities and limitations of this hardware, and understand how external factors such as connection speeds may also impact on the performance of components or systems. • Through a range of individual and group activities, you should introduce learners to the varying roles that software plays in a computer system. Learners should have a clear understanding of how software controls and/or interacts with hardware and other software to enable systems to function. Learners should be able to analyse the use and features of software and the impact these have on computer systems and the subsequent implications for individuals and organisations. • As future technical staff, learners should understand the role of utility software, the importance of drivers in maintaining device operation, the role of security software guarding against external threats or managing staff access to systems. Most importantly, learners should understand that technical staff must be pro-active in terms of managing the systems hardware and software to ensure continuity of service. • Learners should explore the features of computer systems used for data

processing. Learners should be aware of the way in which systems can collect, process, store and manipulate data. This works well when linked to a real example such as sport. Learners could then consider wearable technologies and the data that is gathered through these devices. The data is captured, downloaded and analysed and this helps users to manage their performance. Learners should understand the functions carried out by such systems and be able to analyse the implications of using and protecting individual and multiple systems that store and manipulate data. ● You should give learners opportunities to explore vocational scenarios that require them to explore different choices of hardware and software and allow them to evaluate the appropriateness of computer systems in a range of contexts.This could include Engineering, Research and Development, Crime, as well as the more traditional contexts of Social Media, Communication, Education and Business.
Learning aim B – Computer architecture
● Learners should understand how the individual components can be connected to form computer systems and how the features and characteristics of each of the components affect the system as a whole. ● Learners should be able to analyse the use of different computer architecture models in a range of contexts and would benefit from exploring the use of different approaches in both theoretical and practical activities. You should expect learners to research developments in this field and give them opportunities to build physical and virtual (emulated) systems to meet different success criteria. ● Health and safety and the correct use of PPE and safety equipment should be covered if learners do practical work with computers. You should make clear the dangers of static and potential for shocks from components even if machines are unplugged. ● Once learners have a solid understanding of the principles of system architecture, and have an overview of how the features and characteristics of components affect a system, they should explore the concepts of processor microarchitecture. Learners should be able to explain how the individual aspects of a processor enable it to perform its role. They should be able to analyse how the features and functions of a processor affect mobile, traditional and server computers, and the implications of this on a larger system and its users. ● Learners should understand how data is used by processors and the role of general and special registers in storing, fetching and executing instructions.
Learning aim C – How data is represented by computer systems
● Learners should explore how numbers, text and images are represented as data on a computer system. Learners should be able to work with units of data and perform calculations for binary representations of whole and decimal numbers. You should give learners opportunities to explore the use of number systems in a range of different contexts. ● Learners should explore the use of character representation systems and have a clear understanding of the purpose and implications of using common character sets such as ASCII, Extended ASCII and Unicode. ● You should supply learners with some initial explanation about the theoretical concepts of digital image representation. You should start with the concept of how the data is stored and how the characteristics of the stored data (and how it is collected) affect the resulting image. Exploring the impact of resolution, sampling etc gives an opportunity for learners to engage in a range of practical tasks – learners could use image manipulation software to alter file format, compression method etc of images to see how these affect the characteristics and usability of

the images. Cover common file formats such as .bmp, .jpeg, .giff and .tif, and learners would benefit from saving the same file in different formats to see the difference it makes to the quality of the image. Note that learners should always save from the original image and not from a saved version, otherwise the comparisons will be meaningless. • Learners should have a sound understanding of how using different hardware and software, as well as associated tools and settings, affects the final image. You should give learners opportunities to analyse the use of tools and their appropriateness for a range of scenarios. There is also an opportunity here to consider some of the newer technologies such as the Boomstick, which is not yet widely available. How does this work?
Learning aim D – How data is organised on computer systems
• Learners should have a strong grasp of the features and uses of common data types and structures. You should give learners some initial explanation covering the theoretical concepts of data types and structures. Learners could then carry out individual research to expand on this. • Learners should have a clear understanding of how data types and structures are used by computer systems and how the 'structures' that are seen by the user are represented in the computer system. • Learners would benefit from exploring the use of data types and structures in a practical setting, including their use in database software and in high-level programming languages. One option is to compare a 2D array with an array of records. They might behave in the same way but they are very different data types and structures. • Learners should be able to analyse a range of vocational scenarios to identify and justify using different data structures and consider the implications of the choices they make. • Learners should be able to use and manipulate data stored in matrices. Learners should understand the relationship between matrices and arrays and be confident in using and exploring matrix representation in computers systems. You should supply learners with a range of tasks that require them to be able to perform and interpret processes and calculations using matrices and arrays.
Learning aim E – How data is transmitted by computer systems
• It may be helpful to introduce this topic by first considering different methods of connecting devices and systems together and some of the features and limitations of different connection methods. As well as understanding the types of connection that can be used, learners should be clear about the technical factors that affect connection and transmission methods and the impact these have on their functions, and the resulting implications for individuals and organisations. • Learners need to understand the potential threats to transmitted data and ways in which data can be protected. A presentation from you might be the best way to introduce the subject content, followed by individual and group research tasks, to allow learners to explore potential threats and the characteristics of these threats. Learners can develop their understanding of the impact and implications through case studies and real-world examples. One example could include the dangers of connecting learners' own devices to unsecured wifi and hotspots. Using MIM (Man in the Middle) and Evil Twin techniques to eavesdrop on transmissions, data such as passwords, where you were born, your recent searches, your emails, social media posts etc can be accessed and/or stolen. • Learners should explore ways in which data transmission is helped by data compression. Learners should understand how different compression methods

work, and the implications of using compression when transmitting data.

- Learners should explore the role that protocols play in governing how data is transmitted and the implications of these protocols on users and systems. You might choose to deliver an explanatory presentation of the content to introduce the subject matter, followed by individual research tasks.
- Learners should understand how devices and systems can be connected to form different small- and large-scale systems. Learners should have a strong grasp of how data is transmitted around and between the systems and the format and structure that data takes to ensure effective transmission (including the use of packet data and error detection and correction methods).
- Learners should be aware of how the component parts of a computer system affect data transmission and the impact this has on the function and performance of the system as a whole. The learning for this topic area can be supported by a range of activities including:
  - visits to local employers to see the use of connected systems and how they are used to meet organisational, user and customer needs
  - individual and group research and discussion tasks supported by guest speakers and case studies of real-world examples
  - practical activities involving setting up and using different types of connection.
- You should give learners opportunities to explore using encryption to protect transmitted and stored data. Learners should understand how common encryption methods are used and be able to use and manipulate simple encryption cyphers.
- Learners should be able to consider different scenarios and plan solutions and/or make and evaluate decisions relating to the transmission of data. Learners should be able to consider a wide range of implications and apply them to realistic and varied examples. Where possible, tasks should include a scenario that contextualises the learning. You will need to vary the level of scaffolding you give learners for the devised tasks.
- Due to the integrated nature of many modern systems, and depending on the scenarios used, there will be areas of this topic that you may have already touched upon during previous topics (there are significant links between this topic and topic A). It will be useful for learners if you draw attention to these natural links by giving them learning opportunities (such as visits and case studies) that naturally create links between topic areas.

Learning aim F – The use of logic and data flow in computer systems

- Learners should be able to use, apply and interpret the use of Boolean logic to identify and analyse the logical structures and computer process of a computer system. You should give learners opportunities to explore the use of Boolean logic in diagrammatical and instruction-based formats. There is a natural link between this and many other topic areas, and learners should be able to apply their understanding in conjunction with other knowledge to solve problems.
- Learners should be able to use, interpret and create system diagrams and flow charts to represent computer systems and processes and to solve problems. You should give learners opportunities to explore the use and interpretation of system diagrams and flow charts within vocational contexts and you should help learners to create logical links between this and other areas of the specification.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3: Planning and Management of Computer Projects*
- *Unit 4: Software Design and Development Project*
- *Unit 7: IT Systems Security and Encryption*
- *Unit 9: The Impact of Computing*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in IT. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Journals

- www.mdpi.com/journal/computers
  Free, open-access journal that publishes peer-reviewed academic papers for all computing sectors.

Websites

- www.doc.ic.ac.uk/~eedwards/compsys/index.html
  An academic website for computer architecture and data representation in computer systems.
- www.cs.cf.ac.uk/Dave/Multimedia/node189.html
  An academic website for arrays and digital image representation.
- https://sites.google.com/site/dtcsinformation/home
  An independently maintained computer science website giving an introduction to a number of topics.
- http://pippin.gimp.org/image_processing/chap_dir.html
  This site gives an introduction to digital image representation.
- www.cs.cmu.edu/~adamchik/15-121/lectures/
  An academic computer science resource including arrays, stacks and queues.
- www.gchq.gov.uk/Pages/homepage.aspx
  The government website dedicated to data security.
- www.bbc.co.uk/news/technology
  BBC news and information regarding technology and IT.
- www.forbes.com/technology/
  News and information regarding technology and IT.

UNIT 3: PLANNING AND MANAGEMENT OF COMPUTING PROJECTS

Delivery guidance

Approaching the unit

This externally assessed unit will give learners the transferable skills associated with project planning and management: task scheduling, budgeting, risk management, time management, quality management and communication with stakeholders throughout the life cycle of the project. There are many opportunities to engage in practical work using case study projects and industry standard software tools. Learners should be comfortable with the terminology and be able to extract key information from detailed scenarios.

Learners are likely to work as part of project teams throughout their working life, whether as part of a technical team delivering the product or in the role of project manager. They need to be familiar with a range of tools and techniques to plan and control a project, have an appreciation of the way in which a project serves the business and have a good understanding of the more technical aspects of computing projects. Therefore, it is important to emphasise the links with all aspects of the specification. Guest speakers from local employers would also broaden learners' understanding of project management in the workplace.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

In the external assessment, learners may be tested on all content in the specification. Learners must practise the correct and full completion of any templates given in the sample assessment materials (SAMs) or past papers in preparation for their external assessment task.

Delivering the topics

For topic A, start with some well-known examples of successful projects and compare them with failed or poorly managed projects. Discuss the constraints on a project, such as time, cost and quality. Learners also need to consider the benefits and risks of project management for an organisation and its stakeholders.

Once learners understand what triggers the setting-up of a project and how the eventual outcome is measured, they should look in more detail at the project life cycle. Each stage of the life cycle is studied in greater depth as the unit progresses. Learners must understand the need for professionalism and so end the topic by considering codes of conduct and their influence on project management activities.

Topic B covers the start-up phase of the life cycle and thus focuses heavily on the organisation and the drivers for a computing project. Use a detailed case study, following a similar style to the SAMs, to help learners identify common themes and terminology used in project management.

Present the business case using the template in the SAMs for this unit, so that learners can familiarise themselves with the format of the document. It should set out business reasons for undertaking the project (eg streamlining the business to save money), options that should be considered (eg doing nothing, supplying a minimal solution or suppplying a full solution), expected business benefits, timescale (including the major milestones), the budget available and the major risks that have been identified. You should also guide learners to identify the document's target audience and their requirements, including the tone and the level of detail required.

In addition to considering major risks, learners should identify significant assumptions, such as all resources being available when needed. They should also be able to identify key constraints that will impose limits on the project, such as project funds or technical expertise within the team.

Learners should also be familiar with the range of project stakeholders and the roles they have within a typical project.

Using this information, the learners must be able to complete a project initiation document (PID) using the template given in the SAMs and past papers. Learners should complete this through a series of practical activities.

Use case studies to contextualise the content of topic C. Learners will need plenty of practice in scheduling and budgeting using an industry standard project management application. If your centre does not have access to project management software, learners can create Gantt charts, resource lists and cost plans using a standard spreadsheet application. Alternatively, learners can use open source software, but it must be capable of producing the detail required to achieve the highest grade bands. Learners must be able to use a simple function point analysis approach to estimate the time required for planning software development tasks.

When considering risk management, learners should be given examples of potential risks and discuss their likelihood and impact. They should also be able to identify the more obvious risks in the given scenarios and know that if a risk occurs it is referred to as an issue. You could then move on to discussing quality management in the context of computing projects. Learners need to understand software testing in terms of the time required, when it should happen in the life cycle and how frequently it should occur. Learners should consider the importance of quality standards and their use.

Communication strategies are a crucial topic in this unit, so discuss these with learners in relation to the different stakeholders and the information they require. Ask learners to think about the communication methods that they would choose to use in different scenarios, and why it is important to make the right choice. Learners should also understand the timing of communication in terms of the project life cycle and the frequency of communication for a given task duration.

Topic D is about managing a live project and should be delivered through practical activities. Static case studies may not give opportunities for issue management and change management, so you may need to think creatively to give learners the opportunity to experience these elements of project management.

In your introduction to the waterfall model, you may want to link back to topic C1 (scheduling and milestones), in order to explain the model in the context of scheduling. Learners are not expected to run a project in which they deliver a product, so the waterfall model is used to help with time planning only. However, you could encourage them to use the model to manage their assignment work for other units.

Cover monitoring and tracking progress using project management software to record progress and compare it with the project baseline. Discuss how the project manager can collect progress information and link this to the communication plan.

Learners must be able to record project progress using a checkpoint report. They need to be clear that the report has two parts – the work completed and the work planned for the next phase. Learners should also be clear about the difference between the product and the project. Learners do not need a detailed understanding of change management, but they should appreciate the importance of keeping changes under control and how badly managed changes can lead to the failure of a project.

You could cover implementation strategy, such as the waterfall model, as part of project scheduling, as the strategy chosen will affect project duration.

Link topic E back to topic A in terms of evaluating the success of the project. Learners should be aware of the process of closing down a project. They should discuss the lessons learned from the various case studies used. What went wrong and what went well? Did the contingency plans deal with issues effectively? Where the project ran well, what enabled that success? Lessons learned should also be evaluative.

Finally, learners should consider how additional feedback could be gathered from stakeholders and the methods that could be employed to do this efficiently.

Assessment guidance

This unit is externally assessed through a task set and marked by Pearson. The set task will be completed under supervised conditions in two sessions during the assessment period timetabled by Pearson. Part A will last three hours and Part B will last two hours.

The set task will assess learners’ ability to plan and manage a computing project. Information about the project is released to learners at the start of each session, including background information on the organisation and the proposed project. In Part A, learners will use this scenario to complete various project documentation. They will have to apply a broad range of project planning and communication techniques using the information that they extract from the scenario.

The second part of the assessment uses the same project scenario and the documents that the learners produced in Part A (although these are for reference only and will not be editable). Additional information will be given on the progress of the project up to one of the main milestones. Learners will use this information along with their PID (and plans) to complete a milestone or checkpoint report, which reflects the progress up to that point. Finally, they will produce a short project closure report, in the form of an email, using the additional information given. They should consider the three main success criteria (time, cost and quality), the project management (including planning, risk management and communication), and summarise all the lessons learned from the project.

Getting started

This gives you a starting place for one way of delivering the unit. Activities are suggested in preparation for the external assessment.

Unit 3: Planning and Management of Computing Projects

Introduction

Whether you are building a new website for a small business or rolling out a new patient management system across the entire NHS, the same underlying principles to manage projects are used. The aims of a computing project are to deliver the finished product on time, within budget and to meet the client's requirements. The approach to this unit should maintain a focus on the needs of the organisation that drive a computing project, as well as giving practical experience of using project management tools.

Topic A – Project management concepts

Begin the unit by discussing what defines a project. This should lead to the conclusion that a computing project is usually a one-off piece of work, which can be coordinated using well-established project planning and management techniques to keep it on track.

- Use plenty of real examples and devised case studies throughout the unit. Initially, learners could spend a short amount of time finding examples of real projects to discuss, either by looking online or at handouts. At this very early stage, these examples do not need to be IT-focused, so, for example, learners with an interest in football might enjoy investigating the Wembley Stadium rebuild. From this initial research, aim to draw out the common factors for the success or failure of projects and the three metrics used to evaluate the project: time, cost and quality. Examples of well-known IT project failures could include Sainsbury's warehouse automation in 2005, which cost £150 million before the project was written off. Another example is the UK National Offender Management Information System project (NOMIS) which had similar costs and failed for many reasons. Other similar projects will allow opportunity for investigation and discussion.
- Learners must be able to identify and plan for risks. They could analyse examples of failed projects to establish why they failed and whether, with better planning, these issues could have been avoided. Try to give some examples where serious issues were controlled and overcome by the use of good project management strategies. Learners must have practical experience of quantifying risk in terms of impact and probability to calculate an overall severity score (1–9). Here, you could discuss a project that they can relate to, such as moving house (or upgrading a system such as a product management system, to keep the business focus).
- Understanding the benefits of a successfully delivered project is equally important for the initial business proposal and the final evaluation of the project. You could supply learners with brief descriptions for a number of projects and a list of typical benefits, which they should be able to match up and justify. They should also gain some experience of calculating a return on investment, using a spreadsheet to determine whether a proposed project (given time and cost) will give a financial return over a given period.
- In this unit, learners only need to understand the project life cycle in terms of the framework it allows for structuring a project. Learners should understand that a project process could end as a result of a feasibility study as the decision could be made at that stage not to move forward. This can occur when, during investigation, it becomes clear that the problem is not what was first thought, but something relatively easily fixed. You should stress that taking each step in the life

cycle seriously and ensuring it is done properly will reduce the likelihood of problems later in the process. For example – a badly designed solution that has been rushed will probably result in a badly implemented solution.

- Learners could produce a poster or something similar to track their progress through the unit – by either ticking off the stages as they are covered, or adding further explanations to demonstrate their learning. You could also encourage learners to discuss examples from their project work on internally assessed units and to use these projects to practise and develop their project management skills.
- Introduce professionalism so that learners can see that project management is a well-regulated profession with many opportunities. Direct learners to websites, such as the British Computer Society (BCS) recruitment site, to research IT project management jobs. They should also read, compare and discuss the professional codes of conduct from the Association of Project Management (APM), BCS or Project Management Institute (PMI), to understand that, along with the rewards of this work, there is responsibility. Discuss communication as a professional, transferable skill and ensure that learners understand the importance of using suitable methods of communication and appropriate tone in documentation.

Topic B – Starting up a computing project

Topic B's focus is on the activities associated with the start of the project life cycle that result in the initiation of the project, once it has been established that the project is feasible and could deliver the benefits required.

- Working in groups, learners should put together a business case, which could initially be presented as a gapped handout or matching exercise. From a given business case, they must be able to interpret the expected business benefits, timescales, major milestones, budget and the major risks. Throughout the remainder of the unit, learners should refer back to these points in each business case for the various case study project scenarios that they work with.
- Once you have given an overview of the various stakeholders and their roles within a computing project, learners should construct organisation charts for project teams, showing the range of stakeholders and the relationships between them. Discuss other stakeholders in terms of their contribution to the project or why their views must be taken into account (in particular, the general public, who could be affected by large-scale projects). It could be enlightening for groups of learners to debate project benefits against the concerns of stakeholders for a given case study.
- Learners should be able to identify both assumptions and constraining factors for a given project. Consider assumptions as very low-severity risks which are not captured as part of the risk management process, so they should be documented elsewhere. Give examples of assumptions (eg that the latest version of software will be available to developers) and ask learners to discuss the implications for the project. Learners should understand that assumptions do carry a degree of risk as mistakes made through incorrect assumptions may result in extra work being needed in the long run to resolve. Recap on risk planning. Learners must be able to identify constraints from a given scenario. You could set this as a reading comprehension exercise, leading to another group discussion on the possible effects of the constraints identified.
- The main emphasis of this topic should be the completion of a PID, using the template given in the SAMs. Using the project information covered so far, learners should put together a number of PIDs, based on case studies. They must be able to clearly state project objectives, making them specific, measurable, achievable, results-oriented and time-constrained. This is a significant activity and it would be best to approach it, initially, as a group or paired task, leading up to an individual task. Make sure that learners understand the decisions they need to make about the way in which they communicate through the PID (eg the requirements of the

target audience, the tone, the level of detail and depth of explanation).

- As completing a PID forms a key component of the assessment, learners should also practise completing one under exam conditions. This could form the basis of a formal mock assessment, in which learners could peer assess each other's work and give feedback on strengths and areas for improvement.

Topic C – Project planning

Topic C covers the practical (and transferable) project management skills that learners will use to produce the project plans (for time, cost, quality, risk and communications). This naturally lends itself to practical work using industry standard applications – specialised project management applications and general-purpose office applications such as spreadsheets.

- Introduce learners to a work breakdown structure, as this will give a good starting point for understanding time planning, although learners are not required to produce such a structure. Learners should then work individually to produce comprehensive Gantt charts, using appropriate software. These should show tasks running in sequence (and in parallel where appropriate), indicating milestones using the standard (diamond) symbol and using critical path analysis to identify the critical tasks in the plan. They should identify float (spare time) which could be incorporated into contingency plans.
- Learners should be able to identify all the resources required for a project (staff, equipment and materials) and their associated costs, such as pro-rata costing. A good starting point is to devise a simple spreadsheet for estimating project costs given the quantity of each resource required (or the duration of each task). Once learners have understood how the budget is calculated (bottom up), they could use project management software to set up resource lists and assign these to project tasks. This is a complex and time-consuming process, so allow ample time for learners to become familiar with the software.
- In the previous activities, learners will have seen budget planning examples with clear timescales. Introduce a discussion about how timescales for task completion are estimated. Use examples that are relatively easy to calculate, such as how long it takes to build a wall of a given length and height (knowing the size of a brick and how many bricks can be laid per hour). Explain how the complexity of making such calculations affects software development and introduce the idea of function point analysis as a solution. Ideally, learners should also be encouraged to build in recovery points in the project that allow for unforeseen occurrences such as IT or other technical problems or project team issues such as sickness. Learners should build a spreadsheet to estimate task duration, based on the number of function points required and the rate of development (hours per function point) for different staff.
- Recap risk management, which learners will have covered earlier in the course. In addition to risk analysis, learners should now create contingency plans for any risk with a calculated severity score of 4 or above. Risks with a score of 9 must be avoided or the severity of the risk should be reduced. Learners should revisit their time plans to identify the float available for contingency. They should also consider the impact on the budget and plan for 5 per cent budget contingency.
- You do not need to teach defect removal and testing techniques in depth, but learners will need to understand how these techniques are used and applied, so that they will know when these activities should take place and how to estimate the time required. A simple rule of thumb is that for every hour of development time, plan for an hour of testing. Once again, learners should revisit their time plans to ensure that ample time has been allowed for quality management and testing.
- Learners should discuss the various communication methods used within

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organisations (traditional as well as modern electronic communication methods). They should refer back to their organisation chart and list of stakeholders, and consider the best methods of communication and the ideal frequency of communication. Initially, this might be a tutor-led activity, it will not be easy to extract this information from case-study scenarios because it requires a different perspective. Consider the main reasons for the communication: so that the project team know what they have to do, so the project manager knows how work is progressing, so the client knows how the project is progressing and so that any issues can be dealt with to ensure that the project stays on track. • Using project management software such as Freedcamp, Basecamp or Microsoft® Project (or any other suitable alternative), could be introduced particularly to support communication. This will avoid endless trails of emails and give an auditable trail of communication through using project message boards and discussion threads, alongside automated email updates when there is activity. • As the planning activity is the single largest part of the assessment, learners must have plenty of practice at it, some under exam conditions. They should analyse a scenario, and then devise a time and cost plan using standard software, along with supporting risk and communication plans.
Topic D – Executing and monitoring a project
Learners do not need to manage a live project for this unit. However, they must be aware of the process. In particular, they will be expected to record project progress in a checkpoint report, capture details of issues arising in an issues log and be able to summarise project status in a professional-standard communication. You could encourage them to apply their project management skills to their projects for internally assessed units. • When you introduce the waterfall model (or recap, if it has already been covered elsewhere in the course), you may wish to link back to topic C1. A standard approach for project planning is to allow 15 per cent of execution time for analysis, 30 per cent for design, 25 per cent for development, 25 per cent for testing and quality, and 5 per cent for implementation (delivery/roll-out). Using this model, learners should revisit their project plans and compare their time allocations. • Explain the features of the chosen project management software and how to use it. Give learners plenty of time to practise using scenarios containing the necessary information, so that they become familiar with using the software. • Learners should revisit their communication plan. Discuss how the project manager will use this to track progress of the project tasks and how they will report progress to the project sponsor and the client. Ensure that learners have plenty of opportunities to practise their communication skills, including use of plain English and technical language, using appropriate tone, selecting appropriate information for checkpoint (milestone) reports etc. • Learners must complete a checkpoint report for a simulated project, using the template from Pearson (included in the SAMs). It is important that they understand the difference between the two sections – first, reporting on what has been done up to the milestone, and, second, the work that is planned up to the next milestone. Learners should be aware of how to track project progress against a baseline. If they are using a project management application, this feature of it may be introduced, although it is advanced and is not necessary for the assessment. • Learners should also be familiar with the process of recording issues (risks that have arisen). The PRINCE2:2009 issue register is too complicated for this level, so the assessment will use the template included in the SAMs, which incorporates a simple table in the standard checkpoint report. It is important that learners are able to identify lessons learned from dealing with issues and that these are recorded in

the checkpoint report. The lessons learned will form a significant part of the project evaluation.

- Change management should only be outlined in this unit. Learners should be aware that in a real project any change has to be properly documented, evaluated and authorised, as it will have an impact on time, cost and quality. Emphasise links with quality and testing, as dealing with faults falls into the scope of change management. Discuss the change management process in terms of the communication plan, although learners will not be expected to have practical experience of managing change. Learners should however understand that there needs to be stakeholder buy-in and that not all future users will welcome the proposed changes. Finding ways to encourage participation and give reassurance is part of the project management process.
- Introduce the idea of implementation strategies with a range of examples. Use different case studies so that learners appreciate the differences and how this determines the time that should be planned for roll-out, especially where parallel running or pilot changeover is involved. Learners should understand the link with testing and quality management (beta testing and user acceptance). You may want to explain this using a computing project scenario or case study. Learners must also consider the appropriate implementation strategy for their (case study) project and give a rationale. This could be done as a discussion, presentation or written exercise.

Topic E – Project closure and post-project review

This final topic involves detailed written work for the learners and will engage them in critical evaluation.

- Explain the process of closing down a computing project and moving to the operation/maintenance phase. Learners should revisit their (case study) project and draw together the documentation for review, summarising any lessons learned. Discuss the implications of the learners' projects moving into operation/maintenance. What additional planning and resources are required? Who takes responsibility once the project is closed? A good example is a desktop operating system. Once released, it goes into the maintenance phase, in which regular updates and patches are released. This continues until the operating system reaches the end of its life and support is withdrawn.
- Discuss how you would document the closure of a project in an email. You could write a close-down email as a whole group activity to ensure that learners understand that they must consider the communication requirements of this task. They should suggest the appropriate level of detail and tone for the target audience, as well as balancing the need for plain English with the need for technical detail.
- Learners should discuss ways of capturing feedback on the project, starting from the list of stakeholders and the communication plan. They should consider the range of methods used to gather information and justify why one method is more appropriate for a particular stakeholder. They could devise questionnaires or interview plans for their (case study) project.
- Learners must carry out a detailed evaluation of a project. They should consider the final cost, delivery date and quality of product delivered against the client's requirements and the original plan as set out in the PID, along with the project objectives. Review the lessons learned and, from this summary, evaluate the risk management strategy.
- Learners should be able to identify key lessons that could be used to inform future projects. As well as analysing quantitative feedback (eg completion date and total expenditure), they should also be able to extract qualitative feedback from

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stakeholders and incorporate this into the final project evaluation. Qualitative feedback could also be used to inform lessons learned (eg a departmental manager may comment on how smoothly a process ran, leading to the conclusion that next time the same approach should be used – this is a significant lesson learned from the project).

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 1: Principles of Computer Science*
- *Unit 2: Fundamentals of Computer Systems*

Pearson BTEC Level 3 National Extended Diploma in Business (NQF):

- *Unit 4: Managing an Event*
- *Unit 6: Principles of Management*
- *Unit 13: Cost and Management Accounting*

Other qualifications:

- BCS: Foundation Certificate in IS Project Management

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Hughes B *et al.* – *Project Management for IT-Related Projects: Textbook for the ISEB Foundation Certificate in IS Project Management* (British Computer Society, 2012) ISBN 9781780171180.
  A well-structured book on IT project management, a valuable reference text and quick to read. Suitable for level 3 learners. It is a recommended text for the Foundation Certificate in IS Project Management.
- Jalote P – *Software Project Management in Practice* (Addison Wesley, 2002) ISBN 9780201737219.
  An in-depth study of project management in large-scale software projects which could give useful case study material.
- Lock D – *Project Management*, *Tenth Revised Edition* (Routledge, 2013) ISBN 9781409452690.
  A very in-depth book that goes beyond the scope of this unit, but will give detailed clarification for tutors. Aimed at level 4 learners and above.
- Maylor H – *Project Management*, *Fourth Edition* (Financial Times/Prentice-Hall, 2010) ISBN 9780273704324
  A good introductory text, set out in a learner-friendly style, so worth stocking in the library. Aimed at level 3 learners and above.
- Office of Government Commerce (OGC) – *Managing Successful Projects with PRINCE2, 2009 Edition* (Stationery Office Books, 2009)

UNIT 4: SOFTWARE DESIGN AND DEVELOPMENT PROJECT

Delivery guidance

Approaching the unit

This unit is a mandatory synoptic unit within the Extended Diploma. Ideally, it will be delivered towards the end of the course, as it draws upon the skills that will be developed throughout other units. It assesses learners' ability to design, create and test a software solution under controlled conditions. Explain to learners at the outset that the unit will be externally assessed and that their software solution will need to be either in the C family programming languages or in Python (version 3.4 or later).

Encourage your learners to take notes and create their own reference guides, which they can share with their peers. You could ask learners to create a shared folder for their notes, either on a drive, on the centre's VLE or using a cloud-based service such as Google Drive or Microsoft OneDrive. They can then support each other and use each other's notes to improve their understanding.

It is important to give learners practical activities that will hone their software design and development skills. The activities should be completed under strict time conditions, so that learners know what to expect from the externally assessed exam, which will be time constrained. You must also give learners appropriate feedback on their designs and developments, identifying their strengths and any areas for improvement. You can use this feedback to plan and develop subsequent lessons that will help learners with the skills they need to improve.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

In the external assessment, learners may be tested on all content in the specification. It is essential that learners practise the correct and full completion of any templates given in the sample assessment materials (SAMs) or past papers to prepare for their external assessment task.

Delivering the topics

For topic A, you could start by giving a presentation that introduces the software development life cycle. As part of this, you could discuss the classic 'waterfall' model along with other development methodologies, such as the 'spiral' model. This would also give learners opportunities to compare and contrast these methodologies with the 'waterfall' model.

Learners could work collaboratively in pairs or small groups to research the software development life cycle in more detail. Ensure that each learner understands each stage of the life cycle, focusing especially on the way in which each stage needs to be applied in order to yield the best result. You could encourage learners to present their findings to the rest of the class, and then lead on to a group discussion based on learners' contributions.

For topic B, you will need to show learners how to produce accurate flow charts and pseudocode. These techniques will be useful when learners are assessed on their ability to create a design solution based on a scenario, so make sure that they have the opportunity to test their design skills. You could begin by outlining the fundamental concepts behind each technique. Focus on one technique at a time, giving learners appropriate activities to test their skills in using that technique before moving on to the next. Subsequent lessons should then focus on the design methods that learners will be using in the final design, which should incorporate these techniques.

Following this, learners will need to understand how to create a plan that they can use to test their software solutions. Teaching and learning should focus on why testing is essential as well as how to test against different test criteria. It is important that a range of test data is included within your delivery.

For topic C, start by introducing learners to the various design concepts outlined in the unit content. You will need to clearly explain how each design concept contributes to an accurate, efficient and effective software solution. Conversely, you will also need to explain poor design concepts and how they can be avoided when designing a software solution. This naturally leads on to organisational standards, and explaining, for example, how implementing these standards not only contributes to the quality and readability of the code but also makes programs more maintainable.

This could be an opportunity to have a guest speaker from a software development company. They could share their real-life experiences in the industry and describe the good and poor designs that they have encountered.

For topic D, learners will gain knowledge of how to apply programming techniques in order to produce functional programs. Consider which programming language learners should use, but bear in mind that this unit limits them to using the C family languages or Python (version 3.4 or later). Give learners a range of workbook exercises, which cover the content within topic D. This will support them when they come to code their software solution when completing their final assessment.

For topic E, introduce learners to the key principles of evaluating a software product. Work with learners to develop their analytical and evaluative skills. Learners must be able to evaluate each stage of the development process, and they may require your guidance to achieve this. You could give learners a series of written exercises in which they must critique each stage of a case study software project. Explain to learners that these skills will help them throughout this qualification and beyond, whether they move on into higher education or into industry.

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Assessment guidance

This unit is externally assessed, so it is important that learners understand the constraints of the examination. For example, they can only choose a programming language from the C family or Python (version 3.4 or later), and the assessment will be time constrained. When planning tasks or activities, you should give learners a time allowance to complete each task. You could even use a timer in the classroom to make learners aware of the time constraints.

Give learners mock assessments to complete so that they can build their skills under exam conditions. This will also give you an opportunity to give learners feedback on their skills and point out any areas for improvement.

For full details of assessment, refer to the SAMs and the specification.

Getting started

This gives you a starting place for one way of delivering the unit. Activities are suggested in preparation for the external assessment.

Unit 4: Software Design and Development Project
Introduction Well-designed and well-developed software can be a crucial part of any business or organisation. Software that fails to work will cost money and damage a business' reputation, so it is important that the software development process is always followed correctly and that the final products are fit for purpose. The aim of this unit is for learners to understand the key principles involved in each stage of the software development life cycle. They will use their understanding of these principles to design, test and create a software solution that fulfils the requirements of the solution needed for an appropriate problem and achieves the optimum result.
Topic A – Software development life cycle
• You could begin by introducing the software development life cycle. This should not be restricted to one model. Explain that there are several models that software developers use, for example waterfall, spiral and agile. Explain that different models suit different development situations based on the scope and size of the project and the number and physical locations of potential users. • You could organise learners into pairs or small groups and allocate one stage of the software life cycle model to each pair. Learners should work with others in their group to research their allocated stage of the model, as listed in the specification, and make notes on what they find. You could then lead a plenary session to discuss and clarify each stage of the model, during which you should encourage learners to refine their research notes. Each pair or small group can then upload their notes to a shared folder for the whole class to use when revising and preparing for assessment. • You could set learners a knowledge quiz that they could complete in pairs or individually. Ensure that the questions fully test the learners' knowledge of the software development process. • Give learners appropriate guidance throughout this topic to ensure that they gain the necessary knowledge and skills to implement the process independently later on in the unit.
Topic B – Standard methods and techniques to develop designed solutions
• Start by explaining the skills needed to decompose a problem scenario and develop correct designs. • Allow learners the opportunity to research the different British Computer Society (BCS) flow chart symbols. They could do this individually or in pairs. You could follow this with a direct Q&A session to test learners' understanding. • You will need to explain to learners what flow charts are and how to use them. You could demonstrate a small range of software tools, such as Microsoft Visio® or Word®, to show learners how they can create flow charts. Learners could also explore online tools such as www.draw.io. • Give learners plenty of opportunities to create flow charts based on given scenario-based problems. You will need to give them exercises that gradually build up their

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flow chart development skills and test their knowledge as they learn more. These exercises should begin at a relatively simple level and progressively become more challenging as learners develop their skills and knowledge. Set aside sufficient time to give detailed feedback on these exercises, as this will help learners to become proficient with using flow charts.

- You could use the same process to teach pseudocode. For example, learners could begin by independently researching pseudocode to find out what its use involves. You could then give a presentation on pseudocode that explains how it can be used to solve a specific software design problem. They should understand that there is no formal vocabulary that is specific to pseudocode. Learners could then complete practical exercises to become confident in using pseudocode. You should track their progress, give detailed feedback and ensure that learners really understand what they are doing.
- The final part of this topic concerns software testing. Take the opportunity to explain why software testing is crucial. You could go on to discuss with learners why testing sometimes gets neglected when it comes to the software development process.
- Give learners a testing template, and show them how to fill it in against different test data. Learners will need to practise choosing test data, as most have no difficulty identifying acceptable data that also tests the upper and lower values (say in a range), but most will not think about inputs such as -1 when a positive integer is expected, or inputting a character or symbol. You could then divide the group into pairs and ask each pair to complete a given number of tests. For example, a pair of learners could test the calculator application installed on all computers. The pair could present their test plans to the rest of the class, and you could lead a group discussion on ways to improve and refine the test plan.

Topic C – Software design considerations

This topic will allow learners to explore the good design concepts that should be involved in developing software solutions. Conversely, learners should also appreciate what makes some design concepts poor and understand what aspects of these to avoid when developing software solutions.

- Start with a presentation addressing and briefly explaining each of the design concepts listed in the specification. Once you have explained each concept, learners could research how each of them can be applied to real-life programs.
- Allocate one of the design concepts listed in the specification to each learner in the class. They will need to research how a real-life program or website makes use of this feature and present a short explanation of their findings to the rest of the class. Alternatively, this exercise could be carried out in pairs or small groups. You could combine learners' presentations with a class discussion and ask specific questions about their findings in order to check their understanding.
- You could follow a similar process for poor design concepts. For example, you could begin with a presentation that briefly explains each of the poor design concepts listed in the unit specification. Give learners time to investigate some real-life examples that use these concepts. They can then describe their examples to the rest of the class and explain what makes them poor. You can then ask them questions to test their understanding.
- Investigate whether there are any local software development companies that would like to send someone as a guest speaker. Another option would be to approach alumni from previous BTEC software development programmes who might still be working locally. This would give learners valuable real-life insights into how software design concepts are applied correctly, and the consequences of not doing this. Learners would also have a chance to ask a software developer about

the skills and attributes that they will need if they wish to work within the software development industry.
Topic D – Programming paradigms
This topic will give learners the tools they need to create a software program. When covering this topic, ensure that you focus only on one language. Learners can only use C family programming languages or Python (version 3.4 or later), so focus on one of these languages. Give learners plenty of tuition in the chosen language to address each part of the unit specification. ● Start by presenting learners with the theory behind the way in which data should be handled within a program. As this is a synoptic unit, you will already have covered some elements of this, so you will be able to spend more time giving learners practical activities than focusing on theory. ● When you are confident that learners understand the key concepts, give them several practical exercises to practise these concepts. For example, learners could be given a workbook to work through at their own pace as the topic progresses. This workbook should give them coding snippets to show how the concepts are applied to problems. This will also give you an opportunity to monitor learners' progress. ● As learners hone their programming skills and work through various tasks, it would be useful to bring learners together periodically to recap the skills that they have mastered. Also, when an exercise proves challenging for some learners, you could work through model answers on an interactive whiteboard, with the assistance of other learners in the class. This will also give you a chance to ask learners direct questions to check their understanding. You could ask stronger programmers in the class to formally buddy/work with weaker learners. ● Once all learners have completed their workbooks, you should set them a mock assessment. The mock assessment must reflect the external assessment that they will complete, so it should supply an appropriate problem for which learners can create solutions. This task should be completed independently and individually under controlled conditions that replicate the live external assessment.
Topic E – Evaluating a software development project
● This topic allows learners to evaluate the mock assessments that they completed as part of the previous topic. At this stage, you will need to explain what it means to evaluate and demonstrate how to evaluate something. Some learners will find this aspect of the unit challenging, so you will need to give all learners a level of support that is appropriate to their individual needs. ● Learners should print out their entire mock assessment, including their testing, design and implementation documentation. They can then pair up to evaluate each other's work using annotations to identify strengths and areas for improvement. ● You could as learners to produce a written document in which they evaluate each stage of the software development that they have completed. Their evaluations should be printed or uploaded to the centre's VLE for assessment, and feedback can be given on what they have produced. ● High quality, accurate written and verbal communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Therefore, when developing tasks for learners, you should allow opportunities for this to happen. For example, enable learners to work together collaboratively to develop coding solutions or work together on a presentation to explain the concepts and techniques so you can check their understanding.

- Learners must be able to evaluate the success of a project and the factors that contributed to the outcome effectively, including their own skills, knowledge and behaviours. You could ask learners to create their own blog and evaluate their progress on a weekly basis. The information collated from this could be used to give an overall evaluation of their skills, knowledge and behaviours.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing:

- *Unit 1: Principles of Computer Science*
- *Unit 2: Fundamentals of Computing Systems*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in IT. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Davis S – *C++ for Dummies, 7th Edition* (John Wiley & Sons, 2014)
  ISBN 9781118823774.
  This is a useful guide for introducing C++. It delivers the main concepts addressed in the unit specification.
- Green J – *Head first C#, 3rd Edition* (O'Reilly Media, 2013)
  ISBN 9781449343507.
  This is a guide on how to code using C#. It is a useful book for those who are new to C# programming.
- McGrath M – *Python in easy steps, 1st Edition* (In Easy Steps Limited, 2013)
  ISBN 9781840785968.
  This is useful for those who wish to learn how to program in Python but who have never done it before.

Websites

- www.cplusplus.com/doc/tutorial/
  Clear explanations on the basics of C++, program structure, compound data types, as well as other features useful for programming in C++.
- www.python.org
  The latest version of Python can be downloaded from here for free.
- www.youtube.com/watch?v=tvC1WCdV1XU&list=PLAE85DE8440AA6B83
  The first of 73 video tutorials on how to use C++. It is very useful to anyone wishing to learn C++ programming but who has little experience of using it.
- www.youtube.com/watch?v=4Mf0h3HphEA&list=PLEA1FEF17E1E5C0DA
  The first of 43 video tutorials on how to use Python programming. This is useful to anyone wishing to learn Python programming who has little or no experience of how to use it.

Unit 5: Building Computer Systems

Delivery guidance

Approaching the unit

This internally assessed unit allows learners to explore how computer systems and their component parts are used to solve problems and meet user requirements. You should provide learners with opportunities to develop analytical skills through engagement with a range of vocational scenarios which require learners to plan and build computer systems that meet the needs of an individual or organisation. Learners should have both theoretical and practical experience of selecting and applying a wide range of computing concepts to select, combine and modify, as needed, appropriate hardware and software to produce effective computer systems.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, learners should have an understanding of how different types of computer systems are used by individuals and organisations to complete tasks and meet personal and professional needs. Learners should be able to evaluate the features and characteristics of different devices, the opportunities these present and the resulting implications. Learners should explore how the internal computer components and larger hardware devices can be used individually or in combination with other computer systems. Learners should have a sound understanding of how the features of the individual hardware devices used to form a computer system (including peripherals) affect their use and performance, and how these affect the performance of the system as a whole. Learners should be aware of the important role that software plays in any system and should understand the functions of different types of software. Learners should also have a solid grasp of how system microarchitecture affects the use and performance of a computer system.

Learners should be able to analyse how software and hardware make use of data to achieve identified aims and be able to analyse the impact of these on the overall effectiveness of a computer system and the associated implications for individuals and organisations.

For learning aim B, learners must demonstrate a range of practical project planning and management skills. In preparation for the assignment, you should ensure that learners are familiar with analysing client needs and producing planning documentation that is clear and detailed. Learners should be familiar with effective methods of communicating with others to seek and record feedback in order to refine ideas.

Before starting the assignment, learners will need to have a good understanding of how to plan and build effective bespoke computer systems. Learners should have experience of building and modifying computer systems for a range of requirements, so that they can independently design an effective system that fulfils the requirements of the assignment.

For learning aim C, learners should demonstrate their ability to build and customise a bespoke system from their design specifications. They should be able to select and apply appropriate testing, maintenance and review methodologies to ensure that the system is fully functional and meets the identified requirements of the client. You should ensure that learners have a good understanding of health and safety procedures when building systems and, therefore, that they know and can apply the steps that should be taken to protect both the individual building the system and the intended user(s).

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High quality, accurate communication skills in written and verbal forms are vital to progressing in higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Understand the principles and features of computer systems</td><td>A1 Types of computer systems
A2 Hardware in a computer system
A3 Software in a computer system
A4 Computer system microarchitecture</td><td>A report that examines the relationships between hardware and software within computer systems and the factors that affect their use and performance.</td></tr>
<tr><td>B Design a computer system to meet client requirements</td><td>B1 Computer system requirements analysis
B2 Design documentation
B3 Reviewing and refining designs</td><td rowspan="2">Design specification showing the planning, preparation and design of a bespoke computer system that meets a client’s requirements.
A working computer system which fulfils the design specification accompanied by supporting development and testing documentation.
A report evaluating the computer system against the design specification.</td></tr>
<tr><td>C Develop a computer system to meet client requirements</td><td>C1 Health and safety
C2 Bespoke computer system development
C3 Testing and maintaining a computer system
C4 Lessons learned from developing a bespoke computer system
C5 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This is an internally assessed unit. The recommended assessment approach is for two assignments. The first assignment should assess understanding of learning aim A and the second assignment should cover learning aims B and C.

The assignment for learning aim A could take the form of an academic paper on the features and characteristics of different devices and their use in a range of computer systems. However, a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language. As this is an internally assessed unit, there is an opportunity here to allow users a little latitude in exploring new technologies that might also form part of the solution, particularly as this can still meet the criteria when linked to the effectiveness or performance of systems.

The learners should explore how the intended purpose of a computer system influences its design and application, and how system architecture and the purposes and features of computer systems (including the specifications and features of the hardware and software used) have an impact on the performance and effectiveness of the system as a whole, in comparison to alternative systems. Learners should explore the strengths and weaknesses of different computer types, architecture models and system components and the implications of their use in small- and large-scale systems, justifying their decisions.

The assignment for learning aims B and C should take the form of a practical project. Learners should plan, build, customise and maintain a physical computer system. The scenario for the assignment should provide enough scope to allow the learners to be able to consider different solutions and demonstrate a range of testing and maintenance methodologies. It is important that the context is realistic. Learners should have a 'client' for whom they are developing the system and with whom they will work throughout the project. The scenario should give learners the opportunity to demonstrate the ability to build a bespoke computer system from scratch, using a range of appropriate hardware components and peripherals. Learners should demonstrate the ability to install an appropriate operating system (including additional system software/firmware, as required) and a range of utility and applications software. The scenario should provide learners with scope to demonstrate an understanding of customisation beyond standard installation wizards.

The evidence for this practical assignment should include a project brief, technical specifications, development and testing logs, quality assurance documentation, meeting notes and an evaluation report. Development documentation is likely to take many forms, which may include images/videos of the physical build process and screen captures of the installation, customisation, and set-up stages. The written evaluation should consider how effective the solution was in meeting the identified requirements. It should also make use of the outcomes of testing and reviewing to identify how the solution, and each learner's own performance, could have been improved.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 5: Building computer systems
Introduction Physical computer systems support individuals and organisations in almost everything they do. It is highly desirable for learners to have a sound understanding of how and why components, devices and software are used and combined in all areas of the computing industry. This unit should help learners understand the principles that are involved in using and creating computer systems; it will give them effective practical skills, supported by sound technical knowledge. Learners should be able to apply analytical skills to identify needs, deconstruct problems, devise solutions and evaluate outcomes. These transferable skills will equip learners for further study or employment in a range of vocational areas.
Learning aim A - Understand the principles and features of computer systems
Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● You could begin by introducing the aim of the unit (i.e. to become a highly skilled, technically fluent user of computer systems) and by describing how an understanding of computer systems, including their possibilities and limitations, can be applied to plan systems and analyse and evaluate outcomes or decisions in a variety of situations. ● Introduce learners to the concept that a computer system can be anything from a single digital device to a global collection of computers. Explain that even large IT systems are made up of smaller devices that can perform both an isolated individual role or be part of a larger system. ● It may be beneficial to establish a baseline understanding of learner concepts of digital devices. You should start with common devices such as computers and mobile devices before moving to more specialised or less common devices. You may wish to introduce components and devices along with an overview of the tasks that they can perform, to give the learners a little context. Learners should explore the capabilities and limitations of this hardware, including how the components that form the devices affect their functionality and performance. ● Through a range of individual and group activities, you should introduce learners to the varying roles that software plays in a computer system. Learners should have a clear grasp of how software controls and/or interacts with hardware (and other software) to enable systems to function. Learners should be able to analyse the use and features of software, the impact these have on computer systems and the subsequent implications for individuals and organisations. ● Learners should explore the use of computer systems in a range of vocational contexts. Through their individual and group activities, as well as your presentations, visits and guest speakers, learners should explore a wide range of vocational contexts to see how devices and systems meet a range of needs. Learners should be able to analyse scenarios and evaluate the choices made in terms of the hardware and software used within identified systems. Learners should be able to evaluate the effectiveness of a system in meeting the requirements of identified users and organisations. To ensure a balanced approach, the learners

would benefit from investigating some pc builds that have gone wrong, for example those listed on the PCGamer website.
Learners should understand how individual components can be connected to form computer systems and how the features and characteristics of each of the components (and the ways in which they are connected) affect the system as a whole.

- Once learners have a solid understanding of the principles of system architecture, it will give them an overview of how the features and characteristics of components affect a system. Learners should explore the concepts of processor microarchitecture. Learners should be able to explain how the individual aspects of a processor enable it to perform its role. Learners should also be able to analyse how different processor types (and associated specifications), such as processors designed for mobile, traditional and server computers, have an impact on a system and its users.

Learning aim B – Design a computer system to meet client requirements

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- For learning aims B1and B2, explain to learners how to use a range of planning documents to identify user requirements and plan the scope of a system. Learners should be able to analyse computing needs of a range of vocational scenarios and be able to provide a clear description of user and system requirements. This is essential, as it will form part of the documentation on which an evaluation and review will be based.
- Provide learners with opportunities to explore different contexts in order to suggest the types of hardware and software that are required to support identified needs and processes. Learners should be able to consider different scenarios and plan solutions and/or make and justify decisions. Learners should be able to consider a wide range of implications and apply them to realistic and varied examples. Where possible, tasks should include a specific requirement so that learners can practise providing bespoke designs that meet specific needs. Vary the level of scaffolding provided for the devised tasks. Examples of scenarios could include the following: a system for a graphic artist, a system for a games app developer, a system for a composer/musician that includes sound inputs captured from musical instruments or a system to be used as a database of music items for a hospital radio station.
- In addition to a requirements analysis, documentation for this unit is likely to take the form of project proposals, time plans, development logs and technical specification documents, although it may not be limited to these and may include other project planning aspects such as budgeting and testing requirements.
- To develop strong vocational skills, spend time making sure that learners can manage projects effectively, including organising meetings with the client, recording outcomes from meetings and other forms of feedback, and adjusting plans and timescales for the project, as appropriate.
- Work with learners to ensure that they have effective and appropriate communication skills. Any weaknesses in their communication skills (both oral and written) should be addressed. All project documents and communication with clients should use the appropriate style, tone and content.
- In order to effectively select and plan components for a system to meet the client’s needs, before starting work on the second assignment, you will need to ensure that learners have a strong grasp of the theoretical and practical aspects of building a computer system. Learners will need to know how to set up and modify computer systems, adjust and customise the system (e.g. altering configuration files or

automating processes using macros/scripts) and install, update and maintain software (including operating systems, utility and productivity applications), as required.

Learning aim C – Develop a computer system to meet client requirements

This learning aim should flow naturally from learning aim B and learners will need to be able to apply this understanding as part of a larger project. As with learning aim B, learners need to have a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- For topic C1, learners should be able to follow and apply accepted standard health and safety requirements in the building and use of computer equipment (including protecting the components, the builder and the end user). Learners should be aware of how this may affect the overall system and they should be able to demonstrate that these things have been considered and applied during the system development life cycle.
- At all levels, you should expect learners to demonstrate some degree of customisation of the system (such as altering boot priorities, editing or writing configuration files or automating processes using macros/scripts), in order to meet identified client needs. Customisation of the system should go beyond the use of standard installation wizards.
- You should ensure that learners have access to a range of suitable hardware and software options that can be used as a basis from which to select and build a bespoke computer system. You should spend some time ensuring that learners are able to use appropriate hardware and software to document the build, installation, set-up and customisation procedures undertaken.
- Give learners opportunities to explore a range of testing methodologies to develop understanding of how and why different systems, and parts of a system, are tested in different ways. Learners should be able to select appropriate testing methodologies so that solutions can be thoroughly tested and reviewed. They should be able to appropriately and thoroughly plan and document the testing process. You could develop learners' understanding of the testing and review process by providing them with opportunities to use pre-existing systems, which they can test and review, identifying areas for development. Learners could make use of the outcomes of testing, and reinforce practical skills, by developing systems based on their findings.
- Try to develop learners' evaluative skills. They should be able to use the outcomes of testing and review to evaluate the quality of solutions (and their own performance, as appropriate) against project requirements and client expectations. Learners should understand the role of evaluation and reflection in their own ongoing professional development.
- Work with learners to ensure effective and appropriate presentation skills. All project documents and 'client' communication should use the appropriate style, tone and content. Learners should be confident in one-to-one situations and when communicating to a larger and possibly more formal audience.
- The assignment should provide a valid, vocational context. For the duration of the project, learners will be expected to work with a 'client' who will set the expectations, provide the operating requirements and set and negotiate the timescales etc.
- The 'client', where possible, should be a real-world client with whom the learner can engage. While the project might be 'simulated', in that it may not be a live project, it is invaluable to engage with local employers to provide a vocational setting. If real-world clients are not a possibility, ask another adult to simulate the role of

'client'. Other learners should not fulfil this role, although they could be test users. It is important that the 'client' has a sound knowledge of the project and the related computing requirements.

- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 6: IT Systems Security*
- *Unit 7: IT Systems Security and Encryption*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.doc.ic.ac.uk/~eedwards/compsys/index.html
  This is an academic website for computer architecture and data representation in computer systems.
- www.hse.gov.uk/pubns/indg36.pdf
  Health and Safety Executive. This provides a brief guide on regulations for the use of computer equipment.
- www.torbay.gov.uk/becta_safe_installation_of_ict.pdf
  The BECTA guide to safe IT installation.
- www.computershopper.com/feature/75-pc-building-tips-tools-general-advice
  Computer shopper. This is a guide on building computers which includes safe installation of components. This website also provides other information about a range of hardware and software topics.
- www.bbc.co.uk/news/technology
  British Broadcasting Corporation (BBC). This provides news and information regarding technology and IT.
- www.forbes.com/technology/
  Forbes.com LLC™. This site provides news and information regarding technology and IT.

Unit 6: IT Systems Security

Delivery guidance

Approaching the unit

IT security is one of the primary issues for IT professionals, so this unit is of critical importance to your learners. It is a highly dynamic area of the IT industry, as there are constant technological developments and newly discovered security threats. In many ways, IT security is a struggle between cyber criminals and IT professionals trying to protect personal and business IT systems. This unit provides an exciting and fascinating topic of study for learners to engage with and requires you to keep up to date with the latest IT security developments.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could start with a class discussion about security issues. Many learners will have some experience of this topic and are likely to have heard of some well-known security breaches. However, much of their knowledge is likely to relate to their personal IT use, and you should make it clear that security issues are also of vital importance to business users. You may find it useful to set learners a variety of research tasks, for example asking them to research the most recent incidents of data breaches, virus attacks and politically motivated hacking. There are many genuine news stories on the BBC with many high profile examples, along with websites such as databreachtoday, which is a UK website that raises questions around compliance, security, auditing and data security.

Topic A3 concerns legal requirements, so, to engage your learners, you might ask them to research people, companies or organisations that have fallen foul of these laws, covering not only what they did but also the laws that they broke and the eventual outcome.

Learning aim B concerns the techniques used to protect IT systems, and so can be linked to the threats covered in learning aim A. You could link the two learning aims together, covering the threat and then the associated protection methods. Another approach would be to build on the research task of looking at recent examples of data breaches, virus attacks and so on, and ask learners to consider what protection methods might have been effective in preventing the problems they have researched.

Topic B2, covering policies and procedures, could be contextualised by looking at several different IT, internet or network usage policies. For example, you could take your own centre’s policies and compare them with policies from different types of organisation. You could focus on the purpose of each part of the policies and discuss their appropriateness.

Learning aim C builds upon the knowledge gained in topic B3. It will ensure that learners see that the theoretical content relating to software-based protection links to the practical applications.

For learning aim C, learners will need access to systems on which they can practise their IT systems security skills. It is highly unlikely that they will be allowed to adjust the security settings on the live computing systems within your centre, so you have two options. You could:

- have separate, dedicated, unrestricted computer systems which are not directly connected to the main college/school system
- use virtual PCs. There are a number of software products that allow you to install a software-emulated virtual PC, such as VirtualBox®.

You will also need to provide a Wi-Fi access point for learners to set up and configure in order to cover topic C4. These can be obtained from a range of IT equipment suppliers.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

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Learning aim	Key content areas	Recommended assessment approach
A Understand current IT security threats, information security and the legal requirements affecting the security of IT systems	**A1** Threat types **A2** Information security **A3** Legal requirement **A4** Impact of security breaches	A report explaining different IT security threats, their potential impact on organisations and the principles of information security, including why organisations must adhere to legal requirements when considering security. An evaluation of the effectiveness of different protection techniques.
B Examine the techniques used to protect an IT system from security threats	**B1** Physical security **B2** Policies and procedures **B3** Software-based protection	
C Implement strategies to protect an IT system from security threats	**C1** Group policies **C2** Anti-malware protection **C3** Firewall configuration **C4** Wireless security **C5** Access control **C6** Testing and reviewing protection applied to an IT system **C7** Skills, knowledge and behaviours	Detailed testing documentation explaining how protection techniques can help defend an organisation and a plan showing the protection to be applied to a system to meet specific requirements. Annotated photographic/video evidence of protection measures applied to an IT system. Completed test plan, including reviews of the protected IT system. Annotated photographic/video evidence of improvements and optimisations being made to an IT system. Written or audio/video-recorded justification of planning decisions and an evaluation of the protected IT system.

Assessment guidance

This is an internally assessed unit, meaning that learners need to complete assignments that are devised and marked by your centre and that cover the learning aims. Learning aims A and B are theoretical in nature and the assignment should be based on a case study for a real or fictitious organisation. Evidence could be in the form of a written report or a presentation (with slides and notes) to be given to the company's managers. Alternatively, you could film learners giving their presentations. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Learning aim C requires learners to apply security protection to an IT system. You will need to give them a scenario that provides sufficient detail for them to meet the assessment criteria. For example, they need requirements for different levels of access control (read, modify etc.) to various folders for different users or groups, and the system should require connection to the internet and a Wi-Fi network. The scenario must give sufficient details of the applications and user access required to allow the learners to justify their choice of protection strategies.

The IT system that learners will work on can be either a physical computer system or a virtualised environment. Learners need to provide a portfolio of evidence showing that they planned the protection strategies and can justify their choices. They need to collect evidence of applying the security measures, such as screen shots, photos, videos, witness testimony and so on, and evidence that they have refined and optimised the protection. They also need to include the test plan that they used to test the protected system and a written or audio-/video-recorded evaluation of their plan and its implementation. Learners may find it helpful to maintain a diary of their progress in setting up the system, as this will help them to evaluate the protected system.

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Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 6: IT Systems Security
Introduction Security is a key issue in computing. The aim of this unit is to provide learners with a clear understanding of the threats faced by every IT system and to provide them with the skills to apply the protection techniques required to keep an IT system secure.
Learning aim A – Understand current IT security threats, information security and the legal requirements affecting the security of IT systems
• You could begin by having a class discussion about learners' own experience of security issues and cyber-attacks that have recently been in the news. The ITGovernance website provides a month-by month-breakdown of recent events – for example, in May 2016 we saw a LinkedIn breach and MySpace and Tumblr were also hit. • Learners could work in small groups researching well-known or recent security issues and then present their findings back to the whole class, giving details of the attack. Try to ensure at least one example from each type of threat covered in topic A1 (e.g. internal threats, external threats, physical threats and social engineering and software-driven threats). Facilitate further discussion about how the attacks could have been prevented. You could further extend the discussion by asking learners to consider the impact of these breaches, relating their responses to content covered in topic A4. The technology section of the BBC News website could prove a useful starting point for learners' research. • Work with learners to develop their analytical and evaluative skills. Explore different contexts and give learners opportunities to consider the requirements of each scenario. • Learners need to understand that requirements to protect home personal computers from security threats are different from those required for organisations' systems, and that the consequences of security breaches are different for individuals and organisations. It may be difficult to get industry speakers to talk about specific issues or protection methods, but it would be beneficial to find someone willing to talk to learners about the general security issues and the consequences of these issues on businesses. • Learners could explore the topic of information security through paired work. They could consider examples of confidential information (e.g. bank details or health records) and the way in which the principles of confidentiality, integrity and availability apply to such data. They should also discuss how the data might be misused. Finally, they should consider the impact and potential legal implications of such data being stolen or lost, both for an individual and for the company or organisation that stores the data. • Learners could examine legal requirements using case studies. They could investigate individuals or companies prosecuted under these laws. They can report back on what actually happened, how the legislation was applied and what the consequences were. Learners can find details on the website of the Information Commissioner's Office (ICO), which provides details of cases where they have taken action under the Data Protection Act). • Always check for new legislation that affects IT-related activities. Learners should

understand that, as practitioners, it is their responsibility to stay informed.
Learning aim B – Examine the techniques used to protect an IT system from security threats

- Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.
- You could start by looking at some of the threats that learners identified in learning aim A, and then follow this up with a discussion of the ways in which IT systems can be protected from specific threats.
- Use case studies to allow learners to investigate the physical security measures that could be applied to a specified business IT system. Encourage learners to bear in mind the need to balance the level of threat, the usability of systems and the cost of protection. For example, ask them to consider a number of different scenarios, ranging from top-secret military data to simple business data, such as price lists, and consider what sort of protection would be appropriate in each scenario.
- It may be possible to arrange a class visit from a systems manager employed by a local organisation. Ask them to talk to your learners about the backup and disaster recovery procedures that they use and their organisation's general approach to security. However, you should remind learners that it is unlikely that the visiting speaker will be willing to talk about specific security measures that their organisation takes.
- To cover the topic of policies and procedures, learners could work in small groups looking at some given examples of internet usage policies. You could use the policies of your college or school and local employers where possible; an internet search will produce many global examples. Ask learners to identify the reasons for the 'dos' and 'don'ts' given in these policies, and see if they can spot any omissions without prompting.
- It would be good to deliver topic B3 (software-based protection) in combination with learning aim C. Using this approach, learners could first investigate a software-based protection technique and then attend a practical session where they practise configuring and testing the protection technique. However, an assignment must always cover whole learning aims rather than mixing topics from different learning aims.
- This learning aim provides opportunities for learners to investigate user authentication, which is an area that learners will have experienced (e.g. by signing into school or college systems, social media sites, banking websites or email services). In groups or as individuals, learners could research password-related issues, such as:
  - how to deal with the large number of passwords that users require for accounts on different websites (and how those websites hold these authentication details securely)
  - password good practice
  - non-text-based passwords and other alternative authentication methods.

  Learners could also research and debate the issue of security versus usability, which they will have to consider for topic C6.
- Encryption is an interesting topic that gives plenty of scope for investigation and discussion. You could ask learners to work in small groups to create a variety of simple cyphers, perhaps with a spreadsheet. Ask them to send messages to each other using their cyphers while the other groups attempt to crack the codes and decipher the messages.
- This activity could then lead into a discussion about the difficulties involved in

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creating cyphers and providing cyphers to the receiver in order to allow them to decode the message.
Learning aim C – Implement strategies to protect an IT system from security threats
• This learning aim is primarily practical, with learners practising how to implement the various protection methods that they have examined in learning aim B. They could do this on a physical IT system that is separate from the centre’s live systems; alternatively, if this is not possible, they could do it on a virtualised environment. • Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. • Give learners a case study that explains the system that they are helping to set up and the levels of access to give to different users. Working in pairs, learners could then set up the required folder access controls and test that their set-up works correctly and provides the correct level of access. • When it comes to setting up anti-malware software, firewalls and wireless network security, the results are likely to be predicable if all the learners follow the same procedures. It could be more interesting to ask learners to work in groups and configure these items differently, and then compare the results as a whole class discussion. If network restrictions make it difficult to try out different settings to see how they affect different applications, you could set this as a homework task for learners to try out on their home computers and ask them to report back to the rest of the class on their findings. However, you will need to remind learners not to switch off these features or configure them in a way that would compromise the security of their home systems. • Learners often struggle to test and review their own work effectively, so it may be helpful to ask learners to work in pairs. Each learner could set up a protected system and then create a test plan for that system. Learners should then test and review each other’s protected system following the given test plan. This may help them to be more objective and critical of the degree to which the system is protected and the usability of the protected system. Learners could also use this experience to help them when considering how they could enhance their own protected systems. • Learners should maintain a diary of the various practical activities that they complete in their lessons and the feedback they receive. They can then use this information when they start work on their assignment and can no longer receive detailed guidance from you. • Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 5: Building Computer Systems*
- *Unit 7: IT Systems Security and Encryption*
- *Unit 9: The Impact of Computing*
- *Unit 19: Computer Networking*
- *Unit 20: Managing and Supporting Systems*
- *Unit 29: Network Operating Systems*
- *Unit 30: Communication Technologies*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.bbc.co.uk/news/technology
  BBC News Technology section provides technology news, including cases of significant cyber-attacks.
- ico.org.uk
  The Information Commissioner's Office website gives case studies of action taken under the Data Protection Act.
- home.mcafee.com/advicecenter
  McAfee® security advice centre provides useful and up-to-date information on security, virus attacks and viruses, written in a reasonably accessible manner.
- www.microsoft.com/security
  Microsoft® security advice centre features a regularly updated blog and FAQ on security issues.
- uk.norton.com/security-center
  Norton® security centre provides articles on security, spam email, software piracy etc.
- www.virtualbox.org
  VirtualBox® is a free open source product that allows you to install a software-emulated virtual PC.

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UNIT 7: IT SYSTEMS SECURITY AND ENCRYPTION

Delivery guidance

Approaching the unit

IT security is one of the primary issues for IT professionals, so this unit is of critical importance to all computing learners. It is a highly dynamic area of the industry, as technological developments are constantly happening, in addition to newly discovered security threats. In many ways, IT security is a struggle between cybercriminals and computing professionals trying to protect personal and business IT systems. While this is an exciting and fascinating topic of study for learners to engage with, it can also prove challenging to keep up to date with the latest developments, and you will need to carry out regular research.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could start with a class discussion about security issues. Many learners will have some experience of this topic and are likely to have heard of some well-known security breaches. However, much of their knowledge is likely to relate to their personal IT use, and you should make it clear that this issue is also of vital importance to business users. It might be useful to set learners some research tasks, asking them to look into the most recent examples of data breaches, virus attacks and politically-motivated hacking.

Topic A4 concerns legal requirements, so, to engage your learners, you could ask them to research people, companies or organisations who have broken these laws, covering not only what they did but also the laws that they broke and the eventual outcome.

Cryptography, covered in learning aim B is an interesting but largely theoretical topic that can be very complex. Its history pre-dates the computing age and, of course, code cracking was one of the first purposes that computers were used for. It is worth reminding learners that this technology underpins the internet age and without it there would be no e-commerce, online banking etc. Learning aim B offers many opportunities to engage and enthuse learners, as code cracking is a subject that most of them will find interesting and challenging.

Learning aim C concerns the techniques used to protect IT systems, and so is linked with the threats covered in learning aim A. You could link the two learning aims together, covering the threat and then the associated protection methods. Another possible approach would be to build on the research task of looking at recent examples of data breaches, virus attacks etc, and ask learners to consider what protection methods might have been effective in preventing the problems they have researched.

You could enliven topic C2, covering policies and procedures, by looking at several different IT, internet or network usage policies, perhaps taking your own centre's policies and comparing them with policies from different types of organisation. You could focus on the purpose of each part of the policies and discuss their appropriateness.

You could also consider delivering topic C3 in conjunction with the associated practical tasks in topic D. This will help to ensure that learners can see clearly that the theoretical content relating to software-based protection links to the practical applications.

For learning aim D, learners will need access to systems on which they can practise their skills. It is highly unlikely that they will be allowed to adjust the security settings on the live computing systems within your school or college, so you have two options. You could:

- have separate, dedicated, unrestricted computer systems which are not directly connected to the main college/school system
- use virtual PCs – there are a number of software products that allow you to install a software-emulated virtual PC, such as VirtualBox®.

You will also need to supply a WiFi access point for learners to set up and configure in order to cover topic D4. You can obtain these from a range of IT equipment suppliers.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can record their progress, any issues they encountered and how they overcame them. This will be valuable to them when they are writing their evaluation and reflecting on their own performance as part of the second assignment.

High quality, accurate verbal and written communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Understand current IT security threats, information security and the legal requirements affecting the security of IT systems</td><td>A1 Threat types
A2 Computer network-based threats
A3 Information security
A4 Legal requirement
A5 Impact of security breaches</td><td>A report explaining different IT security threats, their potential impact on organisations and the principles of information security, and why organisations must adhere to legal requirements when considering security.</td></tr>
<tr><td>B Investigate cryptographic techniques and processes used to protect data</td><td>B1 Cryptographic principles
B2 Cryptographic methods
B3 Applications of cryptography</td><td>A report explaining the principles and uses of cryptography, and an assessment on the impact of encryption and security protection, in general, on security and legal issues.
An evaluation of the effectiveness of different protection techniques.</td></tr>
<tr><td>C Examine the techniques used to protect an IT system from security threats</td><td>C1 Physical security
C2 Policies and procedures
C3 Software-based protection</td><td rowspan="2">Detailed testing documentation explaining how protection techniques can help defend an organisation and a plan showing the protection to be applied to a system to meet specific requirements.
Annotated photographic/video evidence of protection measures applied to an IT system.
Completed review of the protected IT system. Annotated photographic/video evidence of improvements and optimisations being made to an IT system.
Written or audio/video-recorded justification of planning decisions and an evaluation of the protected IT system.
A report evaluating the plan and the protected system against the requirements.</td></tr>
<tr><td>D Implement strategies to protect an IT system from security threats</td><td>D1 Group policies
D2 Anti-malware protection
D3 Firewall configuration
D4 Wireless security
D5 Access control
D6 Testing and reviewing protection applied to an IT system
D7 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This is an internally assessed unit, meaning that learners need to complete assignments that are devised and marked internally and that cover the learning aims. Learning aims A and B are theoretical in nature and the assignment should be based on a case study for a real or fictitious organisation. Evidence could be in the form of a written report or a presentation (with slides and notes) to be given to the company's managers. Alternatively, you could film learners giving their presentations. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Learning aim C requires learners to examine the techniques that can be used to protect systems, and learning aim D requires them to apply security protection to an IT system. It makes sense to combine these two learning aims into a single assignment. Supply learners with a scenario that has sufficient detail for them to meet the assessment criteria, firstly, covering the theory behind the protection techniques (for learning aim C), then implementing them (for learning aim D). For example, within the scenario, learners need requirements for different levels of access control (read, modify etc) to various folders for different users or groups, and the system should require connection to the internet and a WiFi network. The scenario should also give sufficient details of the applications and user access required to allow the learners to justify their choice of protection strategies.

The system can be a physical computer system or a virtualised environment. Learners need to put together a portfolio of evidence showing that they planned the protection strategies and can justify their choices. They need to collect evidence of applying the security measures, such as screenshots, photos, videos, witness testimony and so on, and evidence that they have refined and optimised the protection. They also need to include the test plan that they used to test the protected system and a written or audio-/video-recorded evaluation of their plan and its implementation. Learners may find it helpful to maintain a diary of their progress in setting up the system, as this could help them to evaluate the protected system.

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Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 7: IT Systems Security and Encryption

Introduction

Security is a key issue in computing. The aim of this unit is to give learners a clear understanding of the threats faced by every computer system and to give them the skills to apply basic protection techniques, in order to keep a system secure.

Learning aim A – Understand current IT security threats, information security and the legal requirements affecting the security of IT systems

- You might begin by having a class discussion about learners' own experiences of security issues and cyber-attacks that have recently been in the news.
- Learners could work in small groups to research well-known or recent security issues and then present their findings back to the whole class, giving details of the attack. Try to ensure that at least one example from each type of threat is covered in topic A1 (for example, internal threats, external threats, physical threats, and social engineering and software-driven threats). Facilitate further discussion about how it might have been possible to prevent the attacks. Discuss how IT practitioners need to be proactive in terms of promoting IT security as well as being reactive and knowing what to do in the case of a security breach. You could extend the discussion by asking learners to consider the impact of these breaches, relating their responses to content covered in topic A4.
- As IT security is such a fast-moving field, it would be beneficial to ask learners to research the most recently identified threats and breaches. Learners could work in small groups to prepare a brief presentation on threats or security breaches that have occurred in the last six months. Give each group a different recent threat or type of threat to look at. Encourage them not just to look at the mechanism of the threat itself, and the details of the security breach, but also to consider the impact and possible methods of prevention. The technology section of the BBC News website could prove a useful starting point for learners' research, along with industry publications like Computer Weekly and Computing which are both available online.
- Learners need to understand that requirements for protecting home personal computers from security threats are different from those required for organisations' systems, and that the consequences of security breaches are different for individuals and organisations. It may be difficult to get industry speakers to talk about specific issues or protection methods, but it would be useful to find someone willing to talk to learners about the general security issues and consequences faced by businesses. One option is to explore the UK Cyber Security Forum website where the UK has been split into clusters. Information about member companies and regional clusters is available and you could then contact a cluster to find a potential business to work with.
- Learners could explore the topic of information security through paired work. They could consider some examples of confidential information (eg bank details and health records) and explore how the principles of confidentiality, integrity and availability apply to these. They should also discuss how the data might be misused. Finally, they should consider the impact and potential legal implications of such data being stolen or lost, both for an individual and for the company or

organisation that stored the data.

- Learners could examine legal requirements using case studies. They could investigate individuals or companies prosecuted under these laws. They can report back on what actually happened, how the legislation was applied and what the consequences were. Learners can find details on the Information Commissioner's Office (ICO) website, which lists details of cases where they have taken action under the Data Protection Act.

Learning aim B – Investigate cryptographic techniques and processes used to protect data

- Cryptography has a very long history (that dates back to classical Greek times) and learners might find it interesting to look into the history and use of cryptography and its modern equivalents (eg steganography) and many of the features of historical cryptography that underpin the ways it is used today. Group work and research will work well with these topics. If it is possible to arrange a visit to Bletchley Park, near Milton Keynes, this will give learners a useful insight into the history of cryptography.
- You can introduce some basic cryptographic principles in an interesting and practical way by asking learners to attempt to create simple ciphers (for example using shift ciphers and one-time pads) and then attempting to crack each other's ciphers.
- Public key encryption, as used in secure online transactions, is the most widely used modern application of cryptography, but it is quite a complex process to understand. Careful explanation will be required. A search on YouTube or other video-sharing website for 'public key encryption' or 'asymmetric encryption' will list a number of videos, many of which are clear and well explained.

Learning aim C – Examine the techniques used to protect an IT system from security threats

- You could start by looking at some of the threats that learners identified in learning aim A, and then follow this up with a discussion of the ways in which IT systems can be protected from specific threats.
- Use case studies to allow learners to investigate the physical security measures that could be applied to a specified business IT system. This is an opportunity to consider some of the areas of development such as multimodal biometric authentication systems, cloud-based biometric solutions or biometric single signs (SSO). There are other examples such as the use facial recognition to make payments (dubbed the Selfie Payment System) or using facial recognition to authenticate credit cards. Encourage learners to bear in mind the need to balance the level of threat, the usability of systems and the cost of protection. For example, ask them to consider a number of different scenarios, ranging from top-secret military data to simple business data, such as price lists, and consider what sort of protection would be appropriate in each scenario.
- You may be able to arrange a class visit from a system manager employed by a local organisation. You could ask them to talk to your learners about the backup and disaster recovery procedures that they use and their organisation's general approach to security. However, you should remind learners that it is unlikely that the visiting speaker will be willing to talk about specific security measures that their organisation takes.
- To cover the topic of policies and procedures, learners could work in small groups to look at some given examples of internet usage policies. You could use the policies of your centre and local employers, where possible, or an internet search will produce many global examples. Ask learners to identify the reasons for the 'dos'

and 'don'ts' given in these policies, and see if they can spot any omissions without prompting.

- It would be useful to deliver topic B3 (software protection) in combination with learning aim C. Using this approach, learners could first investigate a software-based protection technique and then attend a practical session where they practise configuring and testing the protection technique.
- This learning aim gives learners opportunities to investigate user authentication, which is an area that learners will have experienced (eg by signing into school or college systems, social media sites, banking websites or email services). In groups or as individuals, learners could research password-related issues, such as how to deal with the large number of passwords that users require for accounts on different websites (and how those websites hold those authentication details securely), password good practice, non-text-based passwords and other alternative authentication methods. Learners could also research and debate the issue of security versus usability, which they will have to consider for topic C6.
- Encryption is an interesting topic that gives plenty of scope for investigation and discussion. You could ask learners to work in small groups to create a variety of simple cyphers, perhaps with a spreadsheet. Ask them to send messages to each other using their cyphers, while the other groups attempt to crack the codes and decipher the messages. This activity could then lead into a discussion about the difficulties involved in creating cyphers and giving cyphers to the receiver in order to allow them to decode the message.

Learning aim D – Implement strategies to protect an IT system from security threats

- This learning aim is primarily practical, with learners practising how to implement the various protection methods that they have examined in learning aim B. They could do this on a physical IT system that is separate from the school or college's live systems or alternatively, if this is not possible, they could do it on a virtualised environment.
- Give learners a case study that explains the system that they are helping to set up and the levels of access they need to give to different users. Working in pairs, learners could then set up the required folder access controls and test that their set-up works correctly and gives the correct levels of access.
- When it comes to setting up anti-malware software, firewalls and wireless network security, the results are likely to be predicable if all the learners follow the same procedures. It could be more interesting to ask learners to work in groups and configure these items differently, and then compare the results in a whole class discussion. If network restrictions make it difficult to try out different settings to see how they affect different applications, you could set this as a homework task for learners to try out on their home computers and ask them to report back to the rest of the class on their findings. However, you will need to remind learners not to switch off these features or configure them in a way that would compromise the security of their home systems.
- Learners often struggle to test and review their own work effectively, so it may be helpful for learners to work in pairs. Each learner could set up a protected system and then create a test plan for that system. Learners should then test and review each other's protected system following the given test plan. This may help them to be more objective and critical of the degree to which the system is protected and the usability of the protected system. Learners could also use this experience to help them when considering how they could enhance their own protected systems.
- Learners should maintain a diary of the various practical activities that they complete in their lessons and the feedback they receive. They can then use this

information when they start work on their assignment and can no longer receive detailed guidance from you.

In contrast to *Unit 8: Business Applications of Social Media* where the skills, knowledge and behaviours should be discussed by the group from an external perspective (outside the organisation), in this unit they look inward and at the internal customers within the organisation. They need to know that in a computing/IT role they may well come into contact with most operational departments in an organisation and with most levels of staff from the newest junior to the Chief Executive. Learners should understand that large parts of computing are about process, documentation and professionalism. You should discuss what it means to be professional and why this is important in the industry.

- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 6: IT Systems Security*
- *Unit 9: The Impact of Computing*
- *Unit 19: Computer Networking*
- *Unit 20: Managing and Supporting Systems*
- *Unit 29: Network Operating Systems*
- *Unit 30: Communication Technologies*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.bbc.co.uk/news/technology
  The BBC News Technology section has technology news, including cases of significant cyber-attacks.
- http://ico.org.uk/
  The Information Commissioner's Office website gives case studies of actions taken under the Data Protection Act.
- http://home.mcafee.com/advicecenter/
  McAfee's security advice centre has useful and up-to-date information on security, virus attacks and viruses, written in a reasonably accessible manner.
- www.microsoft.com/security/
  Microsoft's security advice centre features a regularly updated blog and FAQ on security issues.
- http://uk.norton.com/security-center/
  Norton's security centre has articles on security, spam email, software piracy etc.
- http://www.bletchleypark.org.uk/
  Bletchley Park, the national Museum of Computing and wartime code-breaking centre.
- www.virtualbox.org
  VirtualBox® is a free open-source product that allows you to install a software-emulated virtual PC.

Videos

- www.youtube.com
  Search for video presentations on public key encryption:

UNIT 8: BUSINESS APPLICATIONS OF SOCIAL MEDIA

Delivery guidance

Approaching the unit

Social media is an invention of the internet age. Nothing like it existed before, but its influence now is huge and it is an exciting, dynamic area.

However, this unit potentially contains a number of challenges. Firstly, learners are likely to know a great deal about social media from their personal use of it, perhaps even more than you do. You need to emphasise that this unit is not about the personal use of social media but about its use by businesses and other organisations. Secondly, it is a rapidly changing area – current social media sites regularly have new features and adjust existing ones. In addition, new social media sites appear regularly, hoping to challenge the dominance of the hugely successful ones.

You will therefore need to keep up with the latest developments, and ensure that amongst the large amount of information available on this topic from the internet, you are using up-to-date sources. (See, for example, the websites listed at the end of this delivery guide.)

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

Learning aim A starts with a review of social media sites and their features and considers how organisations use them to promote their services. Learners are likely to be familiar with Facebook™ and Twitter but perhaps less so with the sites that are generally less popular with young people (for example, LinkedIn®). Rather than teaching them about the features of these sites, use their existing knowledge but make sure they focus on the business uses.

If you are able to get a visiting speaker from a local business to talk about how and why they use social media, this would be beneficial. A marketing manager (rather than an IT professional) would be a suitable visitor for this part of the unit, as they tend to implement social media strategies within businesses. Alternatively, you could ask the marketing manager from your own centre. You would need to brief the marketing manager by explaining the purpose of this unit and that your learners are IT learners rather than learning about marketing.

The impact and uses of social media is a ‘hot topic’ of which learners will have a lot of experience. Therefore, delivery methods such as debates (for example on the negative impacts of social media) and discussions are likely to be effective.

Learning aim B is about planning a social media campaign. There is quite a lot of marketing-related content and you might want to consider asking one of your college/school business studies or marketing lecturers to talk to your learners about marketing basics.

Learning aim B also focuses on understanding clients' social media requirements. This is another opportunity to invite a guest speaker to talk about working with clients. There are a number of possibilities – you could try to find someone from an advertising agency, or ask a marketing manager to talk about what, as a client, they would expect from someone planning a campaign for the company. There is much information available on the internet about planning social media campaigns, from simple hints and tips to detailed case studies.

Learning aim C focuses on implementing the social media campaign plan and reviewing the results. There will need to be a certain amount of simulation, as learners will need to practise posting materials and reviewing data on the posts. You, other learners, and friends or family familiar with social media can be involved. Learners could, for example, set up a private Facebook™ group to allow other learners, friends and family to interact with them without involving members of the public. It is unlikely that your learners will be able to access social media websites at your centre, so much of the practical work associated with this unit will need to be carried out by learners outside the classroom as homework. Try to ensure that there are plenty of opportunities for review and feedback to help develop skills. Learners could demonstrate their ability to set up posts and collect data about their followers by means of screenshots and printouts. Learners could present these to the class for discussion and feedback.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can record their progress, any issues they encountered and how they overcame them. This will be valuable to them when they are writing their evaluation and reflecting on their own performance as part of the second assignment.

High quality, accurate written and verbal communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

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<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Explore the impact of social media on the ways in which organisations promote their products and services</td><td>A1 Social media websites
A2 Organisational uses of social media for business purposes
A3 Risks and issues</td><td>A report that explores how an organisation can use social media to raise its profile and promote products and services.</td></tr>
<tr><td>B Develop a plan to use social media in an organisation to meet its business requirements</td><td>B1 Social media planning processes
B2 Organisational requirements
B3 Content planning and publishing
B4 Developing an online community
B5 Developing a social media policy
B6 Reviewing and refining plans</td><td rowspan="2">Documentation showing the planning, preparation and implementation of the use of social media in an organisation which meets identified business requirements.
Established social media pages dedicated to the organisation which fulfil the requirements given in the plan, accompanied by supporting documentation.
Statistical data generated by social media websites, including an analysis of how it was used to optimise the use of social media.
A report showing the assessment of search engine rankings.
A report evaluating the use of social media in an organisation against the plan, showing how well it meets the business requirements.</td></tr>
<tr><td>C Implement the use of social media in an organisation</td><td>C1 Creating accounts and profiles
C2 Content creation and publication
C3 Implementation of online community building
C4 Data gathering and analysis
C5 Search engine optimisation
C6 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This is an internally assessed unit and learners will need to complete internally devised and marked assignments to cover the learning aims.

For learning aim A, learners are likely to need to produce a report covering the criteria, although, given the unit topic, electronic delivery (such as via a blog or wiki) might be more relevant. Learners may want to refer to various internet-based examples of how businesses have used social media, and these could be linked to a blog, wiki or other type of electronic document. Some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

With so much material available on social media on the internet, remind learners about plagiarism. Linking to websites and citing fully referenced quotations is acceptable, but copying and pasting text directly from an internet source is definitely not.

Learning aims B and C will be assessed together. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment to teach the content. Selecting a suitable scenario for the social media campaign may need some thought. It is probably unwise to give learners too much detail in the scenario as this will restrict learner choice and may result in learners producing very similar work. Rather than suggesting that learners develop a social media campaign for a specific organisation, you could ask learners to develop a campaign for a local charity or organisation of their own choice. Alternatively, you could give them a small range of different organisations (perhaps four of five of them) to choose from. Each learner needs to plan and implement an individual campaign and it is unlikely that you will be able to use real-life examples, so there will need to be a certain degree of simulation. Learners will need a 'client' to help them understand the requirements of the campaign, and this is likely to be you. Learners will also need an online 'audience' to respond to their campaign posts. Although it may limit the realism, it is probably best if learners largely perform this role for each other. Encourage them to play their roles as realistically as possible, responding to posts as they would in real life. Given the simulated nature of the task and the limited time available to post and respond to comments, the data available for analysis might not be very realistic. However, learners should still be able to comment on and evaluate the information.

Since learners will need to post their material on social media sites that are publically accessible, they will be able to see what everyone else has posted (this is necessary in order to play the role of audience for the process). You will therefore need to stress to learners that plagiarism is not allowed and they must not copy what other learners have done.

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Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 8: Business Applications of Social Media
Introduction Given the dynamic nature of this topic there are plenty of opportunities for research. Learners can also draw on their personal experiences as the 'audience' for an organisation's social media promotions. Make sure, however, that you remind learners that this unit is not about the personal use of social media. It is unlikely that learners will be able to access social media websites from your centre, so much of the practical work and data gathering will need to be carried out by learners outside the classroom as homework/independent study.
Learning aim A – Explore the impact of social media on the ways in which organisations promote their products and services
● Much of the delivery of this learning aim is likely to be based on research into how different organisations have used social media. Due to the dynamic nature of social media, you will need to research current examples to help support your learners. Try to find examples from a wide range of organisations (for example large, small, local, national and international) offering different types of product and services and using social media in different ways (including different social media sites). For example, Toyota and Butlins, Domino's Pizza, Tesco, Nando's, Three Mobile, Nike and Redbull could give you some interesting case studies. Each of these have had, and continue to have, a successful social media presence. ● Give learners opportunities to visit the websites listed in the Resources section of this guide, which contain information about the use of social media for business and marketing purposes. ● Some of the marketing concepts in this unit may be unfamiliar to learners, for example the idea of a target audience. Ask the learners to look at some common print or TV advertisements and discuss what kinds of people they think they are aimed at. List a number of target audiences (in terms of age, gender, education level, etc) and have learners think about the type of material that would appeal to each audience. ● One way in which you can help learners develop the evaluative skills required for the higher grades is to set them a project to research. Ask them to select their favourite social media campaign and then present it to the group, giving reasons why it is their favourite. It is important to remind learners that they need to choose their favourite campaign, not their favourite product, and that they must give clear, detailed reasons as to why it is their favourite. They could also compare their favourite campaign with their least favourite, showing how one engages their interest while the other fails to, and discuss why this is. ● Work with learners to develop their analytical and evaluative skills. Explore different work-based contexts and give learners opportunities to consider the requirements of each scenario. ● If you can arrange a guest speaker, this could be very beneficial for learners. The ideal speaker could be from a small, young company that has used social media to promote its products or services. Alternatively, if your centre has a marketing manager, they may be able to talk to your learners about how they have used social media to attract young people to the college. If you cannot get someone to visit in person, see if it is possible for them to use Skype™ to give a remote presentation and answer learners' questions. Brief the speaker on the sort of topics

they should cover, for example, how they use social media, what they find effective (and ineffective) and the risks and issues of the use of social media.

Learning aim B – Develop a plan to use social media in an organisation to meet its business requirements

- Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment to teach the content.
- If possible, arrange a guest speaker to talk to learners about marketing using social media, and about how to identify and engage a target audience. You may be able to swap a lesson with a business studies tutor, who can explain some of the basics of marketing in return for you talking to their learners about an IT topic. Alternatively, try to find a marketing manager or someone from an advertising agency to talk to learners, either in person or remotely. Brief your speaker carefully about what should be covered, and ask your learners to prepare questions to make the most of the session.
- Learners can develop their planning skills and practise creating engaging content using a case study project. One potential source of case studies could be as follows: each jobcentre (DWP) in the UK has a partner provider business mentoring service that gives business support to new business start-ups on the government's NEA (New Enterprise Allowance) initiative. This will mean a potential pot of new business start-ups where learners could be engaged in helping the individuals with their social media for business strategies. For example, someone starting out as a technical author, taxi driver, catering service, etc. Working in small groups, either give learners, or ask them to select, a social media campaign to plan. Each group needs to use a different case study. There is a wide range of possibilities in terms of case studies. The campaign could be to raise awareness of an organisation, to promote a newly founded organisation, or to promote a specific product or service. The organisation needs to be imaginary but it does not have to be a commercial company. It could be a charity, interest group or society, sports team, music group/band, or other non-commercial organisation. However, it should not be an individual. This project will be invaluable preparation for the final assessment, so encourage learners to take notes and make sure that all group members are fully engaged in the process.
- Learners must obtain feedback on their final projects, so you will need to organise an activity that enables them to practise giving and receiving feedback. To help develop learners' reviewing and evaluating skills, try to organise a review panel for the end of the delivery of learning aim B. This gives learners an opportunity to present their social media campaign plan to a panel of people. Getting the panel together is the main challenge – you need to find either subject experts or members of the public who use social media. For example, you could ask one or two second-year learners to join the panel, or any adult who is a regular social media user. In terms of experts, a member of the business studies tutoring team or a local businessperson could fit the bill. Ask the groups to produce a short presentation of their plan that focuses on their target audience and how they will engage with them. The review panel will give feedback on the plan and suggest improvements. It is important that learners listen carefully and take notes so that they get the maximum benefit from the process.
- Learners often struggle to understand how to justify the decisions they make. One way you can help them to develop these skills would be to hold a university style 'viva' with each group. Go through their social media plans asking questions about why the group chose the various activities in their plan and ask them to explain how the decisions that they made relate to the purpose of the plan and the business requirements.

Learning aim C – Implement the use of social media in an organisation

Learning aim C focuses on learners implementing the plan that they have created and analysing the results.

- Learners need to understand and implement connections between an organisation's social media presence, and their website and other media. This is both in terms of having consistent branding across all their media (for example styles, fonts, colours and logos) and in the links between the website and social media sites (and *vice-versa*). To demonstrate this, learners will need to set up a web page/website for the imaginary organisation for which they are running the social media campaign project. Alternatively, they could further help the New Enterprise Allowance start-ups mentioned in learning aim B. If learners are also completing the website development unit (*Unit 15: Website Development*), then it may be possible to link the two. Alternatively, learners can set up a simple website using, for example, Google's Blogger blog page creation tools. They can also use this site to investigate the use of Google Analytics™.
- Given the practical nature of this learning aim, it makes sense for learners to develop these skills by continuing with the social media campaign they started in learning aim B. Any unused examples from the previous list could be considered, such as Toyota and Butlins, Domino's Pizza, Tesco, Nando's, Three Mobile, Nike and Redbull which could all give learners some interesting case studies. Each of these have had, and continue to have, a successful social media presence. Using a simulated activity requires learners to take the role of social media users interacting with the posts made by other groups. This, of course, will limit the realism of the project, but given the timescales and the nature of the exercise there is not really an alternative. Brief the learners carefully on how to run the simulation, asking them to, as far as possible, behave as they would if it were a real activity. Also, set some ground rules about how they will be expected to interact with the imaginary organisation. This project is a very important 'practice run' for the live assessment and gives you an opportunity to iron out any issues that might occur with the simulation of a real-life social media campaign.
- As already mentioned, developing skills for reviewing and evaluating the process and outcomes is important for obtaining higher grades and for progression to higher education. Once the social media campaign project is complete, ask learners to prepare a presentation on what went well, what did not go so well and how they might change things if they were to repeat the process. This will also help prepare learners for the final assessment. Encourage the whole class to comment on each group's project and to give constructive criticism. Bear in mind that for some criteria learners have to optimise their social media content, so this is something that they need to consider. Feedback from others should help them see how to do this effectively.
- Learners will also need to develop evaluative skills for comparing what they have done in terms of planning and using social media with business requirements to check that their campaign is fit for purpose. Learners will probably benefit from some coaching to help them identify and understand the requirements of a business or organisation. Many of the activities that the learners will be carrying out will be simulated rather than real, so you will need to make the requirements of the imaginary organisations clear to the learners. Group discussions with feedback and guidance from you will help learners develop the required skills to carry out this kind of evaluation.
- Both Twitter and Facebook™ give quite a lot of information about their data collection and analysis tools (Facebook Insights and Twitter Analytics) on their help pages, which learners can work through. There is also a lot of information available about these tools elsewhere on the internet, including a number of video guides on YouTube or other video-sharing websites, which learners may find helpful. The same is true for Google Analytics.

- It will benefit learners to maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- In contrast to *Unit 7: IT Systems Security and Encryption* where the skills, knowledge and behaviours should be discussed by the group from an internal perspective (within the organisation), in this unit they will consider this looking outward or externally - at customers, the public and other external stakeholders. Learners should understand that large parts of computing are about process, documentation and professionalism. You should discuss what it means to be professional and why this is important in the industry.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

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Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 9: The Impact of Computing*
- *Unit 15: Website Development*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.socialmediaexaminer.com
  Social Media Examiner is a blog site with many up-to-date articles about using social media for business purposes.
- www.socialmediatoday.com
  Social Media Today also focuses on social media marketing for business.

UNIT 9: THE IMPACT OF COMPUTING

Delivery guidance

Approaching the unit

Computing has had a tremendous impact on the way people live their lives and it is almost certain that it will have as much, if not greater, impact in the future. Learners will probably have some knowledge of the developments currently taking place, such as driverless transportation, robotics and artificial intelligence, but they may not have considered the impact of these changes, both positive and negative. In many ways this unit requires a degree of 'star-gazing', which learners should find interesting (although you might need to ensure that the discussions stay within the realms of reality!). Try to keep discussion serious as to what impact developments in computing might have in the next five to ten years, as is very difficult to imagine accurately beyond that.

This unit does not involve a great deal of technical skill or practical content. Instead, it is an opportunity to develop soft skills such as research, critical thinking, debate and argument/counter-argument. These skills are very important in higher education and in business.

Remind learners that, as young people who are entering the computing industry, they will have the opportunity to be the people who design, develop and implement technologies that will change the way people live. What could be more exciting and challenging than that?

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

The emphasis in learning aim A is on understanding the impact that computing has had on organisations, and the direction in which computing developments are going. Rather than looking too far back into the past, try to look at the current 'hot topics' in computing and how they are impacting on organisations. At the time of writing, cloud computing and the move to mobile rather than desktop computing are changing the way in which organisations use computers. Up-to-date research using the internet is a vital part of delivering this learning aim, as books are likely to be out of date. Guest speakers from industry can be an effective way to give a real-world perspective on what technologies they see as becoming important in the near future.

In learning aim B, learners need to consider the impacts that developments in computing have had (and will have) on wider society. There are many opportunities for discussion, debate and online research, and for listening to guest speakers. Try to encourage learners to form their own opinions on the key content areas and to present balanced arguments, rather than just reiterating what they find on the internet. Group work followed by feedback sessions and debates may help to develop this approach.

The key to learning aim C is supporting learners in selecting a suitable technology development that they can investigate. It needs to be something reasonably significant without being unrealistic. Involving local business people can really help. For example, if you can find an IT or business manager to talk to the learners about how they recently planned (or are in the process of planning) the implementation of a new technology development (eg moving their data storage to the cloud), this should really help learners understand some of the issues.

In learning aim D, learners will review the plans they have developed. They will need some support in developing the skills needed to create their plan (although some of these skills will have already been taught in *Unit 3: Planning and Management of Computer Projects*). As with learning aims A–C, external involvement can really help learners develop the critical and evaluative skills they need. One possibility would be to get some external feedback from IT/business professionals. This should help learners get a business perspective on their plans and develop their critical thinking skills. Another approach would be to obtain feedback from members of the public who may be affected by the development (rather than the business people implementing the development).

Throughout their practical work, learners should be encouraged to keep a diary in which they can record their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High quality, accurate verbal and written communication skills are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Understand the impact of developments in computing on an organisation	**A1** Hardware and software developments **A2** Changing markets and new opportunities **A3** Emerging technologies **A4** Big data, data warehousing and data mining **A5** Issues and risks	A report with evidence of research on the impact of developments in computing on an organisation and on society as a whole. Recordings of interviews with stakeholders, planning documents.
B Investigate the impact of developments in computing technology	**B1** Social impacts **B2** Employment and business impacts **B3** Environmental impacts **B4** Ethical issues	
C Develop a plan to implement a computing technology development in an organisation	**C1** Information gathering **C2** Implementation planning **C3** Managing risk	A plan for implementing the computer technology, incorporating relevant documentation such as annotated diagrams and evidence of feedback from others (recording of discussions or written feedback). Recorded or written evaluations of the plan and the working practices.
D Review a plan to implement a computing technology development in an organisation	**D1** Obtaining feedback **D2** Review and analyse **D3** Skills, knowledge and behaviours	

Assessment guidance

This is an internally assessed unit and learners will need to complete internally devised and marked assignments to cover the learning aims.

Evidence for learning aim A will come from research that learners have done into the impacts of technology on organisations. Remind learners that they cannot plagiarise information from the internet and they must demonstrate their understanding of the topics they have researched by writing their own explanation and analysis of the impacts. Learners could also draw on the information that they have had presented to them by guest speakers and the class notes that they have taken during discussions and presentations. The end result could be a written document – a report is the most obvious choice, but other formats such as a magazine article, blog or wiki would be good alternatives and would allow learners to demonstrate their creativity, provided the information is communicated in a clear and detailed manner using appropriate language. Some form of audio or visual evidence would also be acceptable.

Highlight the plagiarism issue again when discussing the assessment for learning aim B. Encourage learners to draw on material from classroom discussions, visiting speakers and debates. Remind them that short attributed quotations from the internet and/or books are acceptable but they need to construct a balanced argument, that includes their own opinions, when explaining, analysing and evaluating the social impact of computing. Care should be taken with internet sources – remind learners to check that the source is reputable and up to date. If in doubt, they should check the information against another source.

For learning aim C, learners need to produce a plan for the implementation of a computer development. This is likely to take the form of, for example, a portfolio of evidence, including items such as interview records from stakeholders (written or recorded), a requirement analysis report, implementation plan and notes on methods of risk reduction. Learners need to evaluate their plan to achieve the distinction grade. This could be done as a written report or an audio-recorded discussion.

Learning aim D requires learners to review their plans. The review must include feedback from others (such as stakeholders, their tutor or other professionals). The feedback could be successfully delivered as an audio or video recording or, if this is not possible, it could be written. Learners need to produce their own report to complete the review. It should cover the issue of social impacts and learners' justification of risk-management methods. Delivery is most likely to be in the form of a written report.

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Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 9: The Impact of Computing
Introduction There is very little practical content in this unit, so try to ensure it is interesting and engaging. This could be achieved by including input from external speakers and using a range of activities such as research, feedback activities and debates.
Learning aim A – Understand the impact of developments in computing on an organisation
The overall impact that technology developments can have on organisations covers much more than just the technical issues. Encourage learners to look at the wider impacts, including business impacts and the impacts on employees, customers and suppliers. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment to teach the content. ● Ask an IT or business manager from a progressive, local, medium or large (or small hi-tech) company to talk about how they have used, or plan to use, recent technology developments for the benefit of their business. Has IT, for example, changed the way they employ people (can they access new talent pools using technology), has technology helped them to reduce costs (particularly overheads), have they been able to access new or wider markets, or have the products or services they sell changed in response to technology. They could also potentially talk about the business reasons why they are **not** currently planning to take up a new development (eg a new version of software). Ensure that you brief the speaker and ask them to focus on the business impacts rather than just the technology. ● Learners should debate the concept of the Internet of Things (IoT) - what is it? Are there personal or business benefits to buying into the idea? Are there any negatives? Are there issues of privacy and security? There is significant content to support research in this area on the internet. ● Emerging technologies is an exciting area, which will need to be explored through internet-based research. Split learners into small groups and let them select an emerging technology that particularly interests them. To encourage them to develop ideas and opinions based on their research, ask learners (or groups) to prepare a short presentation on their chosen emerging technology. The presentation should not only cover the technology but also possible impacts, both positive and negative, on organisations and individuals. Encourage learners to ask questions and take notes to support them when they complete the assessment for this learning aim. ● Data warehousing is not a new concept, but the prolific use of the Cloud in data storage is. What are the positive aspects of having your data available in almost any location? Is there a downside? ● What are the issues and risks in relation to people's over-reliance on technology? What would happen if computers ended tomorrow? This is a good debate topic for learners to discuss. How much time do learners spend using technology each day? Is there any time when they are not using technology (apart from when they are sleeping)? Work with learners to develop their analytical and evaluative skills. Explore different work-based contexts and give learners opportunities to consider

the requirements of each scenario.

Learning aim B – Investigate the impact of developments in computing technology

This learning aim is not at all technical but requires learners to consider the impacts that changes in technology have had, and will have in the future, on society. This includes issues such as employment, ethics, social imbalance and the environment.

- Again, a visiting speaker will give learners useful input. As young adults, learners may not fully understand the impact that IT has had on people's day-to-day lives over the last 30–40 years. One possibility would be to ask an older person to talk to the learners and discuss with them how life has changed since the onset of technology. Ensure that you brief the speaker carefully and aim to avoid reminiscences of the 'good old days'. One way to get the most from the session would be to ask the learners to think of everyday activities that include the use of technology, and then ask the guest speaker how these used to be done. Examples could include banking, communicating with friends, purchasing holidays/airline tickets, navigating a car to a destination, completing research for school work and office tasks (typing, filing etc).
- Class debates can be a useful way to help learners develop skills of discussion, for example, by conveying the pros and cons of an argument or forming and explaining opinions. Topics for debate can cover a range of subjects, for example: 'This house believes that the internet does more harm than good' or 'This house believes that robots could become a serious threat to mankind'. Some of the content in learning aim A might also supply some discussion topics. Encourage learners to prepare for the debates through research, to write proper notes for the opening and closing speeches and to make notes about what is said (perhaps you could video the debate for later reference).
- The environmental impact of computing is an area that is frequently overlooked and with the world's dwindling resources this topic is becoming a very important one. What are computers without electricity? What happens to waste equipment? How much of it can really be recycled? For example - PCs are made up of (approximately) 25 per cent plastic, 50 per cent metal, 15 per cent glass and 10 per cent electronic boards, and PCs can contain up to 2 kg of lead. What local facilities are there for to manage the recycling of this technology?
- Learners should explore many of the ethical issues such as the digital divide - for example, does it matter that developing countries and remote areas of the world have little or no access to computers and digital content? Is artificial intelligence a threat to humanity? Does the use of technology essentially mean employees work longer hours? Do their working family members check and respond to emails on business devices outside working hours?
- Ensure that learners understand how to produce the detail required to achieve the highest grade bands in the assessment.

Learning aim C – Develop a plan to implement a computing technology development in an organisation

This learning aim covers creating a plan to implement a technology development. Learners will need some guidance and support on the planning of the technology development, especially since it is a hypothetical implementation. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment to teach the content.

- Learners need to understand how to gather information about a planned new computing development. Practise doing this. The internet is a good resource for gathering information but try to get learners to use other methods too. Discuss the validity and reliability of sources and the appropriateness of relying on sources like Wikipedia.

- In terms of gathering primary data, interviewing stakeholders is one good option – see the specification for other information-gathering techniques. Split the learners into small groups. Then give them – or let them choose – a technology development and ask them to gather information from stakeholders. Many technology developments have an impact on the general public, so this is a convenient group of stakeholders to interview. For example, learners could ask bus users how they feel about driverless buses.
- Help develop learners' planning skills by splitting them into small groups and giving each group a different computing technology development implementation to plan. Each group must work out what the new development is intended to achieve, and the scope, boundaries and constraints of the system. Learners should be introduced to the concept of prioritisation and compromise - that boundaries in cost, timescale, compatibility need to be prioritised (such as "cost is more important than timescale"). They should then create an outline implementation plan. Each group must present their implementation plan to the whole class for discussion and comment on the suitability of the plan. Some aspects of the plan will be pure conjecture, such as costs and overall timescale. Remind learners to make notes about what is said, as this will help them when they come to review the plan for learning aim D.
- Next, help learners understand how to manage the risks of implementing a new technology. Learners should understand, for example, that whilst there is a direct cost to training, there is also a hidden cost (if a member of staff is being trained, who is doing his or her work)? After each group has presented their implementation plan and you have discussed its suitability, allocate time to identify the risks associated with the plan. Aim to end up with a sheet of flipchart paper listing the risks. Learners could then spend time in their groups identifying how each of the risks could be mitigated.

Learning aim D – Review a plan to implement a computing technology development in an organisation

This final learning aim is closely linked with learning aims A–C. It requires learners to review their plans, including the wider impacts, and to justify their choice of risk-management methods. Learners can often find reviewing their own work quite hard, so some practice and guidelines will be beneficial.

- Involving others in the review of learners' plans is a requirement. This can be helpful as it is often difficult to see the issues within your own work. One way to approach this is to try to organise a '*Dragons' Den*' style interview panel. See if you can find three or four people (eg another tutor, a parent or a business person) to sit on the panel. Then ask the small groups who developed their outline plans to present them to the 'Dragons'. Ensure that you brief the panel, making them aware that the review is not just technical but should cover a wide range of issues, including social impacts of the change and the practicality of the plan.
- Another way to help learners develop review skills is to either mix up members between groups or swap plans between groups. This can help reduce the sense of ownership which makes critical review difficult (the 'it's my plan so it must be fine' attitude). Having done this, ask the groups to carry out a SWOT analysis on the plans (Strengths, Weaknesses, Opportunities and Threats). Ask each group to write up their SWOT table on flipchart paper. When they have finished, pin the sheets up and run through the analyses with the whole class.
- Keep on reminding learners to make plenty of notes about what they do and what

you and their classmates say. These notes will help guide them through the live assessment. They will need to plan a different technology implementation but the process should be quite similar.

- It will benefit learners to maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 1: Principles of Computer Science*
- *Unit 2: Fundamentals of Computer Systems*
- *Unit 6: IT Systems Security*
- *Unit 7: IT Systems Security and Encryption*
- *Unit 8: Business Applications of Social Media*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in IT. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Journals

- *New Scientist* (Reed Business Information Ltd)
  This journal covers many developments in technology and other areas.
- *Scientific American* (Nature Publishing Group)
  This journal also covers technology developments, although it can be very technical.

Websites

- www.bbc.co.uk/news/technology
  The technology section of the BBC news website includes up-to-date articles about the latest technology developments.
- www.livescience.com/technology/
  LiveScience is a commercial website with many science- and technology-related articles.
- http://spectrum.ieee.org/
  Spectrum.IEEE is a magazine-style website from the IEEE (Institute of Electrical and Electronics Engineers). There are many articles about developments in engineering, and specific pages dedicated to articles about computing, robotics and other relevant areas.
- www.theguardian.com/uk/technology
  The technology section of *The Guardian* website includes articles on technology, but is mostly focused on consumer electronics.
- www.telegraph.co.uk/technology/
  The technology section of *The Telegraph* website includes articles on technology development, including issues and risks.

Unit 10: Human–Computer Interaction

Delivery guidance

Approaching the unit

This unit gives learners the opportunity to examine the factors surrounding human–computer interaction. The first part of the unit analyses the ways in which technologies are used in everyday society and the effects that they have. Try to introduce various technologies throughout the unit. If possible, invite a guest speaker from a charity to explain how they use technology to support people with physical impairments.

When approaching this unit, it is important to provide a mix of research and practical activities. The activities should engage and compel learners to understand the far-reaching effects that human–computer interaction has. To this end, in their second assessment, learners will have the opportunity to design and develop their own human–computer interaction solution. Prepare learners by encouraging them to consider how real-life computer designs could be improved.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, start by introducing the topic of human–computer interaction and explain how the course will be assessed. Within this learning aim there are opportunities for learners to research several different elements of human–computer interaction. This should lead on to various classroom-based discussions and debates. Furthermore, there are opportunities for local charities to explain how technologies are used to support people with physical disabilities (for example, how blind people can use computers with the use of braille or screen-reading software).

Learning aim A lends itself to using a mix of different delivery methods, including research, group discussions, paired work, debates, individual work, practical-based activities and guest speakers. Try to plan your delivery of the learning aim so that it is engaging and contemporary, and allows learners the opportunity to express themselves in different ways.

For learning aim B, learners will investigate the human–computer interaction requirements of an identified client. Therefore, lesson planning should involve identifying the needs of the client and developing schematic design solutions that have human–computer interaction embedded within them. This learning aim lends itself to learners working collaboratively by combining their ideas and giving each other feedback that will enable them to refine their designs.

For learning aim C, learners will develop a human–computer interaction solution to meet a client’s needs. The second assessment should lead directly from learning aims B and C. (Within learning aim B, learners design their human–computer interaction solution and in learning aim C they have the opportunity to create and test their solution.)

The key objective of learning aim C is to enable learners to create their own human–computer interaction solution. There are different ways to achieve this. The first is to develop a programmable solution (for example, learners could create a graphical user interface). They could do this using an event-driven programming language such as Visual Basic. Alternatively, learners could use Microsoft Excel, with Visual Basic for Applications (VBA) features. In addition, there is an element of flexibility in the way you decide to assess learners. Whatever option you decide on, there need to be opportunities for learners to upskill their knowledge of the program software they are using.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

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Learning aim	Key content areas	Recommended assessment approach
A Examine the factors affecting the development of human–computer interaction	**A1** Developments in electronic devices **A2** User development factors **A3** Use of human–computer interaction in society, and its impact **A4** Design principles of human–computer interaction	A report detailing the developments in human–computer interaction and the effect it has had on society.
B Investigate the human–computer interaction requirements of an identified client	**B1** Requirements for a human–computer interaction solution **B2** Schematic design documentation for a human–computer interaction solution	A practical activity involving the design and preparation of human–computer interaction schematics. The evidence will include: user interfaces (evidenced with annotated screen shots) using software development tools to accurately represent design schematics completed test plans and evidence of optimisation in the form of annotated screen shots. An evaluation of the strengths and weakness of the hardware-based solution or interfaces and potential improvements in design.
C Develop a human–computer interaction solution to meet client requirements	**C1** Content preparation for a human–computer interface **C2** Developing a human–computer interaction solution **C3** Testing an interaction solution **C4** Reviewing the development process and outcomes **C5** Skills, knowledge and behaviours	

Assessment guidance

This unit is internally assessed. The recommended assessment approach is for two assignments. The first assignment should address all the grading criteria from learning aim A. The second assignment combines learning aims B and C.

This is a practical-based unit that allows learners the opportunity to design, create and test a human–computer interaction solution. You could use different and creative approaches to assess the unit. For instance, when learners have produced their human–computer solutions you may decide to allow them to video record themselves with their product. They could provide commentary explaining how the solution works and how it meets the client requirements.

Using different assessment methods will allow learners to express themselves in different ways, provided the information is communicated in a clear and detailed manner using appropriate language. It will also help to make assessment more innovative and engaging.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 10: Human–Computer Interaction

Introduction

Human–computer interaction exists everywhere and is becoming more prevalent. Examples include using a self-checkout at the supermarket, downloading an app to your smartphone, browsing a website and playing an online game. In all these cases, safety, efficiency and intuitiveness had to be considered carefully throughout the design process.

This unit explores the effect that human–computer interaction has, and gives learners the skills to design, create and test their own human–computer interaction solutions.

Learning aim A – Examine the factors affecting the development of human–computer interaction

This learning aim is well suited for learners to work together in pairs or small groups to research the many factors that affect the development of human–computer interaction. Give learners collaborative tasks – they can then share their feedback with the class, which will generate discussion and debate. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Give direct input to learners on how human–computer interaction came to be. There is some early footage of the HCI experience from the 1970s on YouTube, which makes interesting viewing. This is an opportunity to discuss the origin of computers and the innovations made by pioneers such as Alan Turing. You may want to ask learners to carry out research into how technology has developed through the years.
- Put learners into pairs and ask them to investigate how computer games have developed. They can then prepare a presentation to explain their findings to the class. This could include a timeline that charts the progress of improvements in hardware and software development. Learners should present their research and there should be a class discussion. For example, 'This is where we are now – where will it eventually lead?' This is a great opportunity for learners to demonstrate innovation and creativity and an understanding of technologies that are expected to materialise in the medium term
- Develop activities that allow learners to understand how to use human–computer interaction to support the needs of learners with physical disabilities. Learners could undertake research and develop ways of experiencing computer interaction from the perspective of a user with physical disabilities. For example, it would be simple to replicate the effects of how a blind person can browse a website using screen-reader software.
- Find out if any local charities have a representative who would like to talk to learners about using assistive technologies to support people who have impairments. For example, they could discuss how stroke victims can use the eye-gaze system by blinking or how sufferers of arthritis can use tracker balls to move a mouse. Use the guest speaker to spark discussions about accessibility and assistive technologies. If possible, learners should handle some of the hardware-based assistive technologies such as trackballs, sip-and-puff systems, alternative

keyboards and wands and sticks. Allow learners to experience what it would be like to lose one or some of their senses, for example, by restricting their sight so that they cannot fully see.

- Work with learners to develop their analytical and evaluative skills. Explore different contexts and give learners opportunities to consider the requirements of each scenario.

Learning aim B – Investigate the human–computer interaction requirements of an identified client

This learning aim is particularly well suited to learners who want to demonstrate their creativity and flair. Provide learners with practical tasks that allow them to produce different designs to solve a range of problems.

Learners must know how to present a solution using schematic design documentation. It is important that learners understand the guiding principles that underpin Shneiderman's rules. In this learning aim, learners will focus on producing a design that meets the needs of the client, but they will actually implement this solution in learning aim C.

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Give direct input to learners about the documentation they need to use in the design a human–computer interaction solution. They need guidance and support about how to create design schematics. Recap on learning aim A – reiterate that, when designing, they are not designing for themselves, but they are designing for others. Remind them about Shneiderman's design principles.
- Put learners into small groups and give them a scenario within which they must work collaboratively to develop a design. They could use the online presentation tool, Prezi, which allows learners to develop slides that can be shown in real time on the other learners' computers. Scenarios could include:
    - simple maths educational program for under 7s
    - a website for new business support for non-IT literate people (for example, a start-up taxi driver or wedding cake maker)
    - a gym session booking system for novice users
    - an interactive app for new students at your school or college that helps them to find their way around.
- Provide learners with feedback to enable them to refine and improve their designs. It is important that learners understand that in a real-life scenario their initial designs would need to be refined based on user feedback. This will encourage learners to work collaboratively to evaluate and develop their designs in order to achieve the optimal outcome. Learners should incorporate the best ideas to form a final design.

Learning aim C – Develop a human–computer interaction solution to meet client requirements

Learning aim C gives learners the opportunity to use tools for creating their own human–computer interaction solution. This is a natural extension from learning aim B, where learners developed their designs. Using their designs, learners should work on completing solutions that are fit for purpose and that take into account the rules of human–computer interaction.

- Start by reminding learners about learning aim B and the best ways in which they can develop their designs. This will ultimately depend on what exercises you have already given them. Learners should explore the options available to them along

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with the advantages and disadvantages of each method.

- Give direct input to learners about how to prepare content for a human–computer interface. There is scope for the solution to be a programmable one. Therefore, give learners appropriate workbook exercises that will help upskill their programming expertise. This is an opportunity for learners to work independently.
- Encourage learners to work independently, either in small groups or in pairs, so that they can critique each other's human–computer interaction solutions. It is important that learners know how to gain feedback from others in order to improve and optimise their solutions.
- Learners should refine their solutions based on the feedback they receive. Learners should be introduced to the theory of how to give and receive positive feedback. Emphasise how important it is for learners to keep track of the changes that they have made. This is an opportunity for learners to present a 'before' and 'after' solution and to evaluate how their human–computer interaction solutions have improved because of any refinements.
- Give direct input to learners on how to test their human–computer interaction solutions. It is important that learners know about the different types of testing and can use appropriate forms of testing for their solutions. Emphasise the importance of testing to ensure that the solution that they have created is fit for purpose and works correctly.
- Learners should review their final human–computer interaction solutions. There are many elements on which learners can comment, and these are listed in the unit specification. If appropriate, extend the task and allow learners to evaluate the transferable skills, knowledge and behaviours that they have acquired from their experiences of human–computer interaction.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 4: Software Design and Development Project*
- *Unit 9: The Impact of Computing*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 14: Computer Games Development*
- *Unit 15: Website Development*
- *Unit 16: Object-oriented Programming*
- *Unit 17: Mobile Apps Development*
- *Unit 24: Software Development*
- *Unit 25: Web Application Development.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- McGrath M – *Visual Basic in Easy Steps, Third Edition* (Computer Step, 2010) ISBN 9781840784091
  The concepts of how to use objects and provide interactivity have not changed. This title is useful to anyone who wishes to learn Visual Basic.
- Preece J, Sharp H and Rogers Y – *Interaction Design, Fourth Edition* (John Wiley & Sons, 2015) ISBN 9781119020752
  This is an ideal resource for learning the interdisciplinary skills needed for interaction design and human–computer interaction.

Websites

- www.visual-basic-tutorials.com
  Visual Basic tutorials from Visual-basic-tutorials.com. These useful tutorials on how to code in Visual Basic are ideal for learners who are beginners and want to provide interaction to their designs.
- http://hcibib.org
  The HCI Bibliography by SIGCHI (Special Interest Group on Computer–Human Interaction) contains over 123,000 publications on human–computer interaction and is a useful research tool.

- www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/human-computer-interaction-brief-intro
  This is a useful insight into the origins of human–computer interaction and its effects on society by John M. Carroll (via the Interaction Design Foundation website).

Unit 11: Digital Graphics and Animation

Approaching the unit

This unit will provide learners with opportunities to explore the computing principles behind digital images and the associated implications for creating two- and three-dimensional graphics and animation. Learners should apply analytical thinking to examine the use of digital graphics and animation in a range of vocational areas. They will combine their analytical skills with creative proficiency and project management skills to identify and meet the needs of an identified client. The unit is assessed internally.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, it can be useful for learners to start with the concepts of how raster/bitmap images are represented and stored in digital format. Learners should explore the nature of digital images (including colour modes, bit depth and 2D arrays) and how this affects the quality and accuracy of an image. Learners should then explore how vector images are stored and rendered. Learners should explore the computing principles behind 3D image representation with particular emphasis on how the features of coordinate systems affect the rendering of 3D images. Learners should examine a range of techniques used to create and process 2D and 3D animated images. Ideally, learners should be given opportunities to explore the use of graphics and animation in a practical way. However, if this is not possible, you could provide learners with high-quality case studies and engage the help of local employers.

Learners should have a sound understanding of how different techniques and processes affect the quality of images and animation and how this has an impact on their use and the success of a project. Learners should also be aware of the associated legal and ethical considerations when working with images and animation and the implications of these for all project stakeholders.

Learners should apply their understanding of the techniques and computing principles to a range of vocational contexts in order to develop analytical and evaluative skills that allow them to identify, select and justify processing and rendering methods in relation to the outcomes of a project.

For learning aim B, learners will need to understand the practical skills required (learning aim B1) and the underlying theoretical principles (as covered in learning aim A) so that they are able to provide detailed plans that discuss and justify the selection of techniques and processes to create images and animation. You should arrange for learners to spend as much time as possible using some of the graphics and animation packages that are available on the internet to develop practical skills and understanding. Each learner should have the opportunity to produce digital content in response to a range of scenarios.

Learners will be required to demonstrate a number of practical project planning and management skills. In preparation for the assignment, you should ensure that learners are familiar with producing planning documentation that is clear and detailed and that they are familiar with effective methods of communicating with others to seek and record feedback in order to refine ideas.

You should ensure that learners are aware of relevant legal and ethical considerations (such as copyright and royalties) and that they know what constitutes good practice and can provide appropriate documentation.

Learners should be able to demonstrate an understanding of how the mathematical principles and processing techniques used to edit and manipulate digital graphics and animation have an impact on the final outcome and how their use affects the project as a whole.

For learning aim C, learners should develop the necessary practical skills (listed for topic C1) in a range of realistic vocational scenarios in order to implement the designs that they planned in learning aim B. You should ensure that learners have a good understanding of selecting and applying different testing methods, creating and completing test documentation and working with others to review and refine ideas and outcomes. Learners should be able to select and apply appropriate methodologies that test, review and optimise graphics and animations and check the technical and quality characteristics (topics C3 and C4) of the files that they produce. They should be able to review them against the required outcomes of a project.

You should provide learners with opportunities for working with others to identify working parameters and success criteria and to review outcomes. It is important that learners can demonstrate the application of all skills in a realistic project environment. It is very helpful to have the assistance of, and engagement with, local professionals when delivering the content. Guest speakers can provide valuable insight into how digital graphics and animation are used in larger projects. They can also provide examples and case studies relating to the project management skills required in the computing industry.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Investigate the purpose and principles of digital graphics and animation</td><td>A1 Digital image representation
A2 3D image representation
A3 Digital animation techniques
A4 Uses and applications of digital graphics and animation</td><td>A report on the techniques used to produce, store and represent graphics and animation in digital format and the impact of using digital formats to produce these types of products.</td></tr>
<tr><td>B Design digital graphics and animation products to meet client requirements</td><td>B1 Digital graphics and animation planning and design
B2 Design documentation
B3 Digital graphics and animation processes and techniques
B4 Reviewing and refining designs</td><td rowspan="2">A design specification showing the planning, preparation and design of digital graphics and animation products which meets client requirements. Digital graphics and animation files that fulfil the design specification accompanied by supporting development and testing documentation.
A report evaluating the digital graphics and animations against the design specification.</td></tr>
<tr><td>C Develop digital graphics and animation products to meet client requirements</td><td>C1 Digital graphics and animation processing techniques
C2 Testing digital graphics and animation
C3 Reviewing digital graphics and animation
C4 Quality characteristics
C5 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

It is recommended that this unit be assessed as two separate assignments. The first assignment should assess learners' understanding of learning aim A and the second assignment should cover learning aims B and C.

For the assignment for learning aim A, learners could produce a report, based on their own individual research and practical experience, on the techniques used to store, process and create graphics and animation in digital format and the implications of using digital data to represent these types of images. The report could cover an explanation of the features of 2D and 3D digital images, an examination of the uses and application of digital animation techniques in a range of contexts, and the implications of using these techniques for producing animated products. A blog or some form of audio or visual evidence would also be an acceptable alternative to a written report and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

To achieve distinction, learners should also provide an evaluation of the impact that using digital processing, storage and creation techniques have on the characteristics, uses and formats of digital products.

The assignment for learning aims B and C should take the form of a practical project that provides evidence of planning and developing a number of digital graphics and animations for use in a larger digital product. The scenario for the assignment should provide enough scope to allow the learners to be able to consider different solutions to parts of the problem (such as processing and rendering techniques) and demonstrate a range of testing methodologies to ensure that the outcomes meet the project criteria.

It is important that the context is realistic, and that learners have a 'client' for whom they are producing graphic and animation files. Learners should work closely with the client throughout the project to review outcomes and time scales. The 'client', where possible, should be a real-world client with whom the learner can engage. While the project might be 'simulated', in that it may not be a live project, it is invaluable to engage with local employers to provide a vocational setting wherever possible. If real-world clients are not available, a tutor or other adult may simulate the role of 'client'. Other learners should not fulfil the role of client, although they may be test users. It is important that the 'client' has a sound knowledge of the project and the related computing requirements.

The scenario should provide learners with the scope to produce digital graphics and animation that can then be edited into at least two videos for different purposes. The project could involve the production of files that are intended to be incorporated into a larger digital product: however, learners are not required to present the final files as part of a larger product. To be effective, their testing and evaluation should consider, evaluate and justify choices made in relation to the target product and platform.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 11: Digital Graphics and Animation
Introduction Digital graphics and animation play a key role in many areas of, and are related to, the computing industry to enhance products as well as to engage and support users. This unit is designed to provide learners with the skills and understanding to create and manipulate graphics and animation for use on computer systems. Learners will apply practical skills and underpinning knowledge to produce digital graphics for a range of purposes. The unit provides learners with project planning, management and analytical skills that can prepare them for a range of apprenticeships or higher education courses so that they can eventually enter the workplace as professionals in a wide range of computing areas.
Learning aim A – Investigate the purpose and principles of digital graphics and animation
• To begin, you should introduce the overall aim of the unit, providing learners with the 'big picture'. Explain that they will be required to produce two assignments: one that concentrates on learning aim A and one that focuses on learning aims B and C. • You should provide learners with an initial presentation on the theoretical concepts of digital image representation. You could start with the concept of how the data is stored and how the characteristics of the stored data (and how it is collected) affect the resulting image. Learners should explore different image formats and understand how compression has an impact on the quality of the image. • Through a combination of tutor input, independent research and practical application, learners should explore the computing principles of raster and vector images and should explore their use, and the implications of their use, in a range of contexts. Learners should have a solid grasp of the ways in which the application of processing techniques and manipulation of the features of an animation or graphic have an impact on the final outcome and the implications of this for users and other key stakeholders. • Learners should be aware of how the principles of 2D images translate to the rendering of 3D images and should explore the principles and applications of 3D images, with particular focus on the use of coordinate systems. • You should provide learners with opportunities to develop their analytical and evaluative skills by exploring the effects of using digital graphics and animation within different contexts. Learners should understand how and why different processes are used and be able to select different processes to meet identified needs, justifying their choices. • You should spend time exploring how the final outcomes of a graphic or animation are affected by the use and application of the file (e.g. intended audience, target format/platform or required features) across a range of contexts and combinations of characteristics to ensure a wide understanding. • Learners should have a thorough understanding of how legal and ethical considerations would affect the process and final outcomes of a digital graphic and animation project, particularly, in terms of the ownership of content and how to acquire permissions to ensure that the law is not broken. In addition, they could

discuss the ethics of airbrushing celebrity publicity images and the refusal of some celebrities to accept this (such as the incidents in 2016 with Meghan Trainor who published the original and the digitally altered versions of her music video).
Learning aim B – Design digital graphics and animation products to meet client requirements
Learners should be competent and possess a range of skills and knowledge before starting the assignment, which should not be used as a vehicle to teach the content. • You should provide learners with opportunities to develop the practical application of creating, sourcing, processing and editing digital graphics and animations. It is important that learners have a sound understanding of what can, or cannot, be done, as well as having realistic ideas of the resources and timings required, before they start to plan a project. After an initial presentation from you to provide them with introductions to software-specific skills, it would be useful for to learners to develop their skills through tasks involving responding to realistic, vocational scenarios. Scenarios could come from marketing, events management and the leisure industry, all of which are heavy users of digital graphics and animation. • For B2, you should teach learners how to use a range of planning documents to identify user requirements, plan the development process (including sketches of initial ideas, tools and techniques to use and time scales) and identify and set success criteria/project parameters. Documentation requirements for this unit are varied and learners will need to know about different styles of documents in varying levels of detail, depending on the situation/project. However, it is likely that most, if not all, areas listed in topic B2 should be included to a greater or lesser extent. Learners need to be aware that planning documents should be clear and detailed and provide a vehicle for discussion with the client (and other relevant parties) to ensure that the project is efficient and outcomes are accurate. As a general guide, planning documents must contain sufficient detail so that (as may be the case in a real-world situation) a third party could take the planning documentation and continue the project without any input from the original designer. • Learners should be able to demonstrate an understanding of the impact that the mathematical principles and processing techniques used to edit and manipulate digital graphics and animation have on the final outcome, and the implications for the project as a whole. They can demonstrate this in many ways and it is likely to be a multi-stage process. For instance, they can include details of a rotation or transformation in an animation's storyboard, whereas the discussion and justification for its use may be presented elsewhere, such as in communications with the client or review documents. • It is likely that learners will make use of a wide range of sources for their work and therefore should be aware of, and comply with, the associated legal, ethical and practical considerations. Learners should be equipped with the analytical understanding to choose appropriate sources as well as the skills to produce their own assets, as required. • You should ensure that learners have sufficient time to develop strong vocational skills and can manage projects effectively. These skills should include organising meetings with a client, recording outcomes from meetings and other forms of feedback, and adjusting plans and timescales for the project, as appropriate. • You should work with learners to ensure that they have effective and appropriate communication skills. All project documents and communication with clients should use the appropriate style, tone and content.

Learning aim C - Develop digital graphics and animation products to meet client requirements

Understanding of this learning aim should flow naturally from learning aim B and learners will need to be able to apply this understanding as part of a larger project. As with learning aim B, learners should be equipped with a range of practical skills and associated theoretical knowledge before starting the assignment. The assignment should not be used as a vehicle to teach the content.

- You should provide learners with opportunities to develop the practical skills of sourcing, processing and editing digital graphics and animations. Learners should have a thorough understanding of how to use appropriate hardware and software to select and apply appropriate processing tools and techniques (as listed in topic C1) to produce graphic and animation audio files to fulfil the requirements identified in the specification.
- Learners should explore the use of digital graphics and animations in a range of contexts and consider how the purpose, audience, target file type/size and target platform affect the choice of processing method. Learners should be able to evaluate the requirements of different scenarios and be able to select and justify the use of appropriate tools and techniques.
- Learners should be able to select appropriate testing methodologies so that outcomes can be thoroughly tested and reviewed. They should be able to appropriately and thoroughly plan and document their selected testing processes. Learners should have a strong grasp of a range of formative and summative testing and review methods and should be able to appropriately select, apply and justify the use of these to ensure that the outcomes of the project meet the needs of the identified client.
- To develop understanding of the testing and review process, you could provide learners with graphics and animations created by others (and associated project criteria) that they could test and review, identifying areas for development and ways of improving the files. It would be beneficial for learners to have access to editable versions of the files so that they can explore the tools and techniques used, and make adjustments and improvements, as necessary.
- You should also help to develop learners' evaluative skills. Learners should be able to use the outcomes of testing and review to evaluate the quality of solutions (and their own performance, as appropriate) against the requirements of a project and client expectations. Learners should be taught the skills to enable them to deliver and receive positive feedback and constructive criticism.
- It is important to work with learners to ensure that they develop effective and appropriate presentation skills. All project documents and communication with clients should use appropriate style, tone and content, with workshops provided to improve learners' skills if needed.
- The assignment should provide a valid, vocational context and learners are expected to work with a 'client' for the duration of the project, who will set the expectations, provide the operating requirements and set and negotiate timescales of the project. The 'client', where possible, should be a real-world client with whom the learner can engage. It is important that the 'client' should have a sound knowledge of the project and the related computing requirements.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 14: Computer Games Development*
- *Unit 15: Website Development*
- *Unit 16: Object-oriented Programming*
- *Unit 17: Mobile Apps Development*
- *Unit 24: Software Development*
- *Unit 25: Web Application Development*
- *Unit 27: 3D Modelling*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in IT. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.cs.cf.ac.uk/Dave/Multimedia/node189.html
  This is an academic website for arrays and digital image representation.
- www.digitaltutors.com/subject/3d-animation-tutorials
  Pluralsight. This gives tutorials on using a range of different digital animation software programmes.
- www.nyfa.edu/student-resources/best-free-open-source-animation-software
  New York Film Academy. This is a guide and links to a range of open-source animation software.
- www.creativebloq.com/graphic-design/free-graphic-design-software-8134039
  This is a guide and links to a range of open-source digital graphics software.
- www.digitalartsonline.co.uk
  An online magazine dedicated to digital graphics, animations and associated fields. It contains, features, reviews guides and tutorials.

Unit 12: Digital Audio

Delivery guidance

Approaching the unit

This internally assessed unit has been designed to enable learners to explore the principles that underpin the production, manipulation, storage and use of audio in digital format. Learners should apply analytical and creative skills to identify and meet the needs of users through the production and manipulation of audio data. A thorough understanding of computing principles should be supported by creative skills, with particular focus on how these affect digital audio and, ultimately, the aims and success of a project.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A it may be helpful for learners to start with the concept of binary data, and then progress to the difference between binary and analogue signals. Exploring binary representation of sound will naturally overlap with 'sampling', and introducing some of the concepts of sampling (for example, that a binary number will represent one point on an analogue waveform) will provide learners with a natural cognitive link between the two topic areas. When exploring sampling, learners should understand the underlying computing principles of analogue to digital conversion (with reference to the Nyquist–Shannon sampling theorem).

As well as understanding the key theoretical principles, it would be useful for learners to explore how the concepts affect sampling, and other associated topics (A1.3 and A1.4), in a practical way. Learners should have a sound understanding of how different processing and storage methods (including compression and file type) affect the audio data and, in turn, how this has an impact on the use of the audio file and the success of a project.

When delivering the content, you should try to make sure that there is a balance between the underlying theoretical knowledge and the practical application of the associated skills. Learners should explore the use and implications of digital audio in a range of vocational contexts. This will help them to develop analytical and evaluative skills so that they can learn to identify, select and justify sampling and processing methods in relation to the outcomes of a project.

For learning aim B, learners will be required to demonstrate a number of practical project planning and management skills. In preparation for the assignment, you should ensure that learners know how to produce planning documentation that is clear and detailed and that they are familiar with effective methods of communicating with others to seek and record feedback in order to refine ideas. You should ensure that learners are aware of relevant legal and ethical considerations (such as copyright and royalties) and that they know how to follow good practice and can provide appropriate documentation.

Before they start the assignment, learners will need to have a good understanding of the practical skills required (learning aim C1) and the underlying theoretical principles so that they can provide detailed plans that discuss and justify the sampling, processing and storage considerations and their relevance to the assignment scenario. As with learning aim A, learners should explore the concepts and skills in a range of realistic, vocational contexts.

For learning aim C, learners should develop the necessary practical skills (listed for topic C1) in a range of realistic vocational scenarios in order to implement the designs that they planned in learning aim B. You should ensure that learners have a good understanding of selecting and applying different testing methods, creating and completing test documentation and working with others to review and refine solutions. Learners should be able to select and apply testing methodologies that assess the technical and quality characteristics of the digital audio that they produce and be able to review them against the required outcomes of a project.

Learners need to have opportunities for working with others to identify working parameters, success criteria and to review outcomes. It is important that learners can demonstrate the application of all skills in a realistic project environment. It would be very helpful to have engagement with, and the assistance of, local professionals when delivering the content. Guest speakers can provide valuable insight into how digital audio is used in larger projects or could provide examples and case studies relating to the project management skills required in the computing industry.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Examine the principles that underpin digital audio</td><td>A1 Digital representation of audio
A2 Storing and using audio in digital form</td><td>A report on the techniques used to record, store and represent audio in digital format, the relationship between analogue sound and digital data and the implications of using digital formats to store and reproduce sound.</td></tr>
<tr><td>B Design digital audio to meet client requirements</td><td>B1 Digital audio planning and design
B2 Planning and design documentation
B3 Sourcing digital audio assets
B4 Reviewing and refining designs</td><td rowspan="2">A design specification showing the planning, sourcing and processing of a range of sounds in readiness for an identified digital product.
A selection of digital audio files which fulfil the design specification, accompanied by supporting development and testing documentation.
A report evaluating the digital audio files against the design specification.</td></tr>
<tr><td>C Develop digital audio to meet client requirements</td><td>C1 Digital audio processing methods
C2 Testing digital audio
C3 Reviewing digital audio
C4 Quality characteristics
C5 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

It is recommended that this unit should be assessed as two separate assignments. The first assignment should assess learners' understanding of learning aim A and the second assignment should cover learning aims B and C.

The assignment for learning aim A could take the form of an academic paper that explores how the characteristics of digital audio and associated sampling, conversion and processing techniques have an impact on how the sound is represented in digital format. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Learners will need to explore the effect of using sound in digital format on reproduction of the original sound and how different techniques for processing and storing audio have an impact on the audio files, target product and, where appropriate, the user.

The assignment for learning aims B and C should take the form of a practical project that provides evidence of planning and developing a number of different digital audio files for at least two different uses. The scenario for the assignment should provide enough scope to allow the learners to be able to consider different solutions (such as different sampling and processing methods) and demonstrate a range of testing methodologies to ensure that the outcomes meet the project criteria.

It is important that the context for the assignment is realistic, and that learners have a 'client' for whom they are producing digital audio files. Learners should work closely with the client throughout the project to review outcomes and timescales. The 'client', where possible, should be a real-world client with whom the learner can engage. While the project might be 'simulated', in that it may not be a live project, it is invaluable to engage with local employers to provide a vocational setting. If real-world clients are not available, a tutor or other adult may simulate the role of 'client'. Other learners should not fulfil the role of client, although they may be test users. It is important that the 'client' has a sound knowledge of the project and the related computing requirements.

The scenario should provide learners with the scope to produce a range of sounds for different purposes. Learners are not required to present the final audio files as part of a larger product. To be effective, their testing and evaluation should consider, evaluate and justify choices made in relation to the target product and platform.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 12: Digital Audio

Introduction

Digital audio is used in all aspects of the computing industry to enhance products as well as to engage and support users. This unit is designed to provide learners with the skills and understanding to source, manipulate and produce audio files for use by computer systems. Learners will apply practical skills and their underpinning knowledge to produce digital audio for a range of purposes. The unit provides learners with project planning, management and analytical skills that can prepare them for a range of apprenticeships or higher education courses, so that they can eventually enter the workplace as professionals in the creative computing field, for example as audio digital signal processing engineers.

Learning aim A – Examine the principles that underpin digital audio

- To begin, you could introduce the overall aim of the unit, providing learners with the 'big picture'. Explain that they will be required to produce two assignments: one that concentrates on learning aim A and one that focuses on learning aims B and C.
- You should provide learners with an initial presentation on the theoretical concepts of digital representation of audio data. It can be useful for learners, when linking concepts, if you start with the idea of binary and refer to the relationship between the binary data and the sampling of analogue sound data.
- Learners should explore the concepts of sampling (with reference to the Nyquist–Shannon sampling theorem) through a combination of input from you, independent research and application of practical skills. Learners should explore how the listed features affect the sound, and associated data, during the process of analogue to digital conversion.
- You should provide learners with opportunities to learn about the characteristics and implications of storing and using digital audio. Learners should explore how, for example, the choice of file format or compression method (as in learning aim A2) affects the audio data and the implications this has for the future use (including the impact on the target product and user).
- Learners need opportunities to develop their analytical and evaluative skills by exploring the effects of using audio in digital form within different contexts. Learners should understand how and why different processes are used, and be able to select different processes to meet identified needs, justifying their choices.

Learning aim B – Design digital audio to meet client requirements

Learners should be competent and possess a range of skills and knowledge before starting the assignment, which should not be used as a vehicle to teach the content.

- You should provide learners with opportunities to develop the practical skills of sourcing, processing and editing digital audio. It is important that learners have a thorough understanding of what can, or cannot, be done as well as having realistic ideas of the resources and timings required, before they start to plan a project.
- For B2, you should teach learners how to use a range of planning documents to identify user requirements, plan the production process (including the tools to use and timescales) and identify and set success criteria/project parameters.

Documentation for this unit will vary and learners will need to know about different styles of document, in varying levels of detail, depending on the situation/project. Learners must be aware that planning documents should be clear and detailed and provide a vehicle for discussion with the client (and other relevant parties) to ensure that the project is efficient and that outcomes are accurate.

- Learners should explore different sources of digital assets (as listed in B3) and the associated legal, ethical and practical considerations. They will need to have the analytical understanding to choose appropriate sources as well as the skills to produce their own assets, as required. Learners should be introduced to the concept of creative ownership/intellectual property and how to acquire permissions to ensure that the law is not broken. In addition, they could discuss some of the high-profile court cases concerning the use of sampling.
- In order to develop strong vocational and employability skills, you must ensure that learners know how to manage projects effectively. This will include organising meetings with a client, recording outcomes from meetings and other forms of feedback, and adjusting plans and timescales for the project, as appropriate.
- You should work with learners to ensure that they develop effective and appropriate communication skills. All project documents and communication with clients should use appropriate style, tone and content.

Learning aim C – Develop digital audio to meet client requirements

Understanding of this learning aim should flow naturally from learning aim B and learners will need to be able to apply this understanding as part of a larger project.

- You should provide learners with opportunities to develop their practical skills of sourcing, processing and editing digital audio. Learners should have a thorough understanding of how to use appropriate hardware and software and how to select and apply the processing methods listed in topic C1 in order to produce audio files that fulfil the requirements identified in the specification.
- Learners should explore the use of digital audio in a range of contexts and consider how the purpose, audience, target file type/size and target platform affect the choice of processing method. Learners should be able to evaluate the requirements of different scenarios and be able to select and justify the use of appropriate tools and techniques.
- Learners should be able to select appropriate testing methodologies so that outcomes can be thoroughly tested and reviewed. They should be able to appropriately and thoroughly plan and document their selected testing processes.
- In order to develop their understanding of the testing and review process, you could provide learners with audio files created by others (and associated project criteria) that they could test and review, identifying areas for development and ways of improving the files.
- You should also help to develop learners' evaluative skills. Learners should be able to use the outcomes of testing and review to evaluate the quality of solutions (and their own performance, as appropriate) against the requirements of a project and client expectations. Learners should be taught the skills to enable them to deliver and receive positive feedback and constructive criticism.
- It is important to work with learners to ensure that they develop effective and appropriate presentation skills. All project documents and communication with clients should use appropriate style, tone and content.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

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- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 10: Human–Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 13: Digital Video*
- *Unit 14: Computer Games Development*
- *Unit 15: Website Development*
- *Unit 16: Object-oriented Programming*
- *Unit 17: Mobile Apps Development*
- *Unit 24: Software Development*
- *Unit 25: Web Application Development*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- http://www.jiscdigitalmedia.ac.uk/guide/an-introduction-to-digital-audio
  Jisc Digital Media. This site gives an introduction to the concepts of digital audio.
- http://www.indiana.edu/~emusic/etext/toc.shtml
  Indiana University (Prof. J Hass). This is an academic website with information about computer music.
- http://music.columbia.edu/cmc/MusicAndComputers
  Burk/Polansky/Repetto/Roberts/Rockmore. This is an academic website with information about computerised music, including digital representation of sound and sampling.

Unit 13: Digital Video

Delivery guidance

Approaching the unit

This internally assessed unit has been designed to provide learners with opportunities to explore the principles that underpin the production, manipulation, storage and use of video in digital format. Learners should apply analytical and creative skills to identify and meet the needs of users through the production and manipulation of digital video resources. A thorough understanding of computing principles should be supported by creative skills, with particular focus on how these affect digital video and ultimately the aims and success of a project.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, it may be helpful for learners to start with research into how still images are represented and stored in digital format. Learners should explore how the nature of digital images (including colour modes, bit depth and 2D arrays) has an impact on the quality and accuracy of an image. After they have explored digital image representation, learners can link this to digital video through common properties such as image quality.

Learners should examine how digital moving images are generated by capturing a series of still images and how the process of capturing images and representing them as digital video affects the accuracy and quality of what is seen. Learners should have a good understanding of how image acquisition and the subsequent data (e.g. how it is stored, compressed and transmitted) have an impact on its quality and use.

It would be useful for learners to explore the concepts affecting video capture, and other associated topics (A1 and A2), in a practical way. Learners should have a sound understanding of how different processing and storage methods (including compression and file type) affect the video data and, in turn, how these have an impact on the use of the audio file and the success of a project.

When delivering the content, you should try to make sure that there is a balance between the underlying theoretical knowledge and the practical application of the associated skills. Learners should explore the use and implications of digital video in a range of vocational contexts. This will help them to develop analytical and evaluative skills so that they can learn to identify, select and justify sampling and processing methods in relation to the outcomes of a project.

For learning aim B, learners will be required to demonstrate a number of practical project planning and management skills. In preparation for the assignment, you should ensure that learners know how to produce planning documentation that is clear and detailed and that they are familiar with effective methods of communicating with others to seek and record feedback in order to refine ideas. You should ensure that learners are aware of relevant legal and ethical considerations (such as copyright and royalties) and that they know how to follow good practice and can provide appropriate documentation.

Before they start the assignment, learners will need to have a good understanding of the practical skills required (learning aim C1) and the underlying theoretical principles (learning aim A) so that they can provide detailed plans that discuss and justify the capturing, sourcing, processing and storage considerations and their relevance to the assignment scenario. As with learning aim A, learners, should explore the concepts and skills in a range of realistic, vocational contexts.

For learning aim C, learners should develop the necessary practical skills (listed for topic C1) in a range of realistic vocational scenarios in order to implement the designs that they planned in learning aim B. You should ensure that learners have a good understanding of selecting and applying different testing methods, creating and completing test documentation and working with others to review and refine ideas and outcomes. Learners should be able to select and apply testing methodologies that assess the technical and quality characteristics (learning aims C3 and C4) of the digital videos that they produce and be able to review them against the required outcomes of a project.

Learners need to have opportunities for working with others to identify working parameters, success criteria and to review outcomes. It is important that learners can demonstrate the application of all skills in a realistic project environment. It would be very helpful to have engagement with, and the assistance of, local professionals when delivering the content. Guest speakers can provide valuable insight into how digital video is used in larger projects or could provide examples and case studies relating to the project management skills required in the computing industry.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skills, knowledge and behaviours.

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<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Examine the principles that underpin digital video</td><td>A1 Digital representation of video
A2 Storing and using video in digital form</td><td>A report on the techniques used to record, store and represent video in digital format and the implications of using digital formats to store and reproduce video.</td></tr>
<tr><td>B Design digital video to meet client requirements</td><td>B1 Digital video planning and design
B2 Planning and design documentation
B3 Sourcing digital assets
B4 Reviewing and refining designs</td><td rowspan="2">A design specification showing the planning, sourcing and processing of a range of digital content to produce digital videos for specific, identified purposes.
Digital videos that fulfil the design specification accompanied by supporting development and testing documentation.
A report evaluating the digital videos against the design specification.</td></tr>
<tr><td>C Develop digital video to meet client requirements</td><td>C1 Digital video processing methods
C2 Testing digital video
C3 Reviewing digital video
C4 Quality characteristics
C5 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

It is recommended that this unit be assessed as two separate assignments. The first assignment should assess learners' understanding of learning aim A and the second assignment should cover learning aims B and C.

The assignment for learning aim A could be in the form of a written report that explores how the characteristics of digital image representation, digital video and associated acquisition, rendering and processing techniques have an impact on how still and moving images are represented in digital format. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Learners will need to explore the effect of using video in digital format on the reproduction of the image and how different techniques for processing, storing and transmitting video (such as compression) have an impact on the video data, target files, target product and, where appropriate, the user.

The assignment for learning aims B and C should take the form of a practical project that provides evidence of planning and developing substantive digital video files for at least two different uses. The scenario for the assignment should provide enough scope to allow the learners to be able to consider different solutions (such as different sources, acquisition techniques and processing methods) and demonstrate a range of testing methodologies to ensure that the outcomes meet the project criteria.

It is important that the context for the assignment is realistic, and that learners have a 'client' for whom they are producing digital video files. Learners should work closely with the client throughout the project to review outcomes and time scales. The 'client', where possible, should be a real-world client with whom the learner can engage. While the project might be 'simulated', in that it may not be a live project, it is invaluable to engage with local employers to provide a vocational setting. If real-world clients are not available, a tutor or other adult may simulate the role of 'client'. Other learners should not fulfil the role of client, although they may be test users. It is important that the 'client' has a sound knowledge of the project and the related computing requirements.

The scenario should provide learners with the scope to produce and source video footage that can be edited into at least two videos for different purposes. The project could involve the production of videos that are intended to be incorporated into a larger digital product: however, learners are not required to present the final video files as part of a larger product. To be effective, their testing and evaluation should consider, evaluate and justify choices made in relation to the target product and platform.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 13: Digital Video

Introduction

Digital video is used in many areas of, and related to, the computing industry; it can enhance products as well as engage and support users. This unit is designed to provide learners with the skills and understanding to source, manipulate and produce video files for use on computer systems. Learners will apply practical skills and their underpinning knowledge to produce digital video for a range of purposes. The unit provides learners with project planning, management and analytical skills that can prepare them for a range of apprenticeships, or higher education courses, so that they can eventually enter the workplace as professionals in the creative computing field, for example as multimedia consultants.

Learning aim A – Examine the principles that underpin digital video

- To begin, you could introduce the overall aim of the unit, providing learners with the 'big picture'. Explain that they will be required to produce two assignments; one that concentrates on learning aim A and one that focuses on learning aims B and C. Ensure that learners have a range of skills and knowledge before starting the assignment. Do not use the assignment to teach the learning aim.
- You should provide learners with an initial presentation on the theoretical concepts of digital image representation. Start with the concept of how the data is stored and how the characteristics of the stored data (and how it is collected) affect the resulting image.
- Learners should explore the properties of digital video and how the processes of capturing and rendering digital video (including aliasing, quantisation, overload and progressive scan and interlace) affect the quality and usability of digital video. They can do this through a combination of input from you, independent research and application of practical skills. Learners should be introduced to the concept of creative ownership/intellectual property and how to acquire permissions to ensure that the law is not broken.
- You should provide learners with opportunities to find out about the characteristics and implications of storing and using digital video. Learners should explore how, for example, the choice of file format or compression method (learning aim A2) affect the underlying video data and the implications this has for the future use (including the impact on the target product and user).
- Learners need opportunities to develop their analytical and evaluative skills by exploring the effects of using video in digital form within different contexts. Learners should understand how and why different processes are used and they need to be able to select different processes to meet identified needs, justifying their choices.

Learning aim B – Design digital video to meet client requirements

Learners should be competent and possess a range of skills and knowledge before starting the assignment, which should not be used as a vehicle to teach the content

- You should provide learners with opportunities to develop the practical skills of sourcing (including the use of cameras and screen-capture software), processing and editing digital video. It is important that learners have a good understanding of what can, or cannot, be done as well as having realistic ideas of the resources and timings required, before they start to plan a project.

- For B2, you should teach learners how to use a range of planning documents to identify user requirements, plan the production process (including the tools to use and timescales) and identify and set success criteria/project parameters. Documentation for this unit will vary, and learners will need to know about different styles of documents in varying levels of detail, depending on the situation/project. Learners must be aware that planning documents should be clear and detailed and provide a vehicle for discussion with the client (and other relevant parties) to ensure that the project is efficient and outcomes are accurate.
- Learners should explore different sources of digital assets (as listed in B3) and the associated legal, ethical and practical considerations. Learners should have opportunities to explore the use of all the sources listed so that they acquire the ability to analyse and choose appropriate sources for a given scenario. Learners should develop the skills to produce high-quality original assets that enhance their videos.
- In order to develop strong vocational and employability skills, you must ensure that learners know how to manage projects effectively. This will include organising meetings with a client, recording outcomes from meetings and other forms of feedback, and adjusting plans and timescales for the project, as appropriate.
- You should work with learners to ensure that they develop effective and appropriate communication skills. All project documents and communication with clients should use appropriate style, tone and content.

Learning aim C – Develop digital video to meet client requirements

Understanding of this learning aim should flow naturally from learning aim B and learners will need to be able to apply this understanding as part of a larger project. As with learning aim B, learners should be equipped with a range of practical skills and associated theoretical knowledge before starting the assignment. You should not use the assignment as a vehicle to teach the content.

- You should provide learners with opportunities to develop their practical skills of sourcing, capturing, processing and editing digital video. Learners should have a thorough understanding of how to use appropriate hardware and software to select and apply the processing methods listed in topic C1 in order to produce video files that fulfil the requirements identified in the specification.
- Learners should explore the use of digital video in a range of contexts and consider how the purpose, audience, target file type/size and target platform affect the choice of processing method. Learners should be able to evaluate the requirements of different scenarios and be able to select and justify the use of appropriate tools and techniques.
- Learners should be able to select appropriate testing methodologies so that outcomes can be thoroughly tested and reviewed. They should be able to appropriately and thoroughly plan and document their selected testing processes.
- In order to develop their understanding of the testing and review process, you could provide learners with video files (and associated project criteria) created by others that they could test and review, identifying areas for development and ways of improving the files.
- You should also help to develop learners' evaluative skills. Learners should be able to use the outcomes of testing and review processes to evaluate the quality of solutions (and their own performance, as appropriate) against the requirements of a project and client expectations. Learners should be taught the skills to enable them to deliver and receive positive feedback and constructive criticism.

- It is important to work with learners to ensure that they develop effective and appropriate presentation skills. All project documents and communication with clients should use appropriate style, tone and content.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 2: Fundamentals of Computer Systems*
- *Unit 10: Human–Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 14: Computer Games Development*
- *Unit 15: Website Development*
- *Unit 16: Object-oriented Programming*
- *Unit 17: Mobile Apps Development*
- *Unit 24: Software Development*
- *Unit 25: Web Application Development*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.lwks.com
  Lightworks. This site provides industry level, cross platform video editing software. Free, Pro and Educational versions are available.
- www.videosoftdev.com
  Flash-Integro LLC. This site provides free video-editing, screen-capture and video-capture software.
- natron.inria.fr
  This site provides free, open-source video compositing software.

Unit 14: Computer Games Development

Delivery guidance

Approaching the unit

The purpose of this unit is to provide learners with practical experience of designing and developing computer games. Learners will spend time investigating the computer games industry before assuming the role of a software developer within the games industry and analysing popular genres to design and develop their own computer games.

Learners should have access to adequate game development environments (such as those stated in the unit specification) in order to complete the assessments for this unit. Preferably, they should have access to a selection of environments, as this will enable greater opportunity for comparison with development options.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could begin by discussing computer gaming in general. Learners could talk about their favourite computer games and genres. You should be careful here as there is potential for learners to get carried away with talking about their favourite games. To this end, try to focus learners on why particular games are their favourites. What makes them come back to these games? This could lead to discussions about different kinds of player, which could include age range, gender or casual versus immersive gamers, for example. At this point, you could also discuss the different ways of producing games, for example mainstream publishers, indies or free-to-play.

After discussing games and genres, move on to how games are played. Do learners prefer multiplayer or single-player games? Discuss multiplayer systems and the way they are implemented and maintained. Talk about how this leads to distribution platforms and integrated services, such as Steam and Google® Play Also, discuss concerns relating to multiplayer platforms such as how they can be kept secure. Initiate discussion about the way in which single-player games are implemented. Talk about how developers create convincing artificial intelligence.

Learners should investigate the hardware and software technologies available for use in computer games and what difference they can make to their design, development and distribution. Explain the benefits and limitations of different platform options for the development of computer games. Learners should discuss what effect new technologies have on the computer games people play and how this affects the design and development of these games. Discuss the uses of game engines and their capabilities and the way in which they help computer game developers.

If possible, invite guest speakers from game developer studios to convey the current state of development processes and emerging areas. This should help highlight the need to keep up to date with technology.

In learning aim B, learners design a computer game. As with any software design, they should be familiar with the scope of the design. You should guide learners in the process of choosing appropriate models to use in their designs. Learners should be familiar with techniques used in game design and be confident in the application of the ones that they will use in their own designs.

Throughout this learning aim and learning aim C, impress upon learners the stages of software development, including analysis, design (in learning aim B), and development and testing (in learning aim C). Ensure that learners understand what is required in the analysis and design of a computer game, and in the management of a software development project. You could encourage them to apply the project management skills that they acquired in *Unit 3: Planning and Management of Computing Projects* to their projects.

Set aside time for learners to review their designs with their peers and, if possible, practitioners. They could do this through presentations or seminars, where they could ask questions and make suggestions for improvement.

In learning aim C, give learners as much practical experience as possible. Introduce the use of development environments early on and allow learners time to experiment with the tools available. Ensure that you give learners the opportunity to develop their skills using their chosen environment so that they can make use of the advanced features listed in the unit specification.

In learning aim C, learners will complete their development projects. You should ensure that they are proficient with the development and testing stages of software development.

Allow time for learners to review their own draft computer games and those of their peers. Try to do this late enough that the learners have working games, but early enough that they will have time to make refinements based on the feedback they receive.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

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Learning aim	Key content areas	Recommended assessment approach
A Investigate technologies used in computer gaming	**A1** Social trends in computer gaming **A2** Technologies used in computer gaming	A report investigating and evaluating social and technological trends in gaming and how they would influence the development of new computer games.
B Design a computer game to meet client requirements	**B1** Computer games design processes and techniques **B2** Design documentation **B3** Reviewing and refining designs	A design specification showing the design and development of a computer game to meet identified client requirements. Project brief, design documentation, development and testing logs, meeting notes and a report that evaluates the effectiveness and appropriateness of the computer game. The evidence should also suggest ways in which solutions could be improved and/or alternative solutions that could be used if the task were to be repeated.
C Develop a computer game to meet client requirements	**C1** Principles of computer games development **C2** Developing computer games **C3** Testing computer games **C4** Reviewing computer games **C5** Quality characteristics **C6** Skills, knowledge and behaviours	

Assessment guidance

This is an internally assessed unit. The recommended assessment approach is for two assignments.

Assignment 1 should cover learning aim A. The assignment should analyse computer games, and the trends and technologies that exist within the industry. It should also discuss emerging trends and technologies, for example the developments in wearable technologies, and their impact on computer games development. The assignment could be delivered as a website as part of an ezine. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Assignment 2 covers learning aims B and C. This assignment should be project-based, where learners design and develop their own computer game. Learners should try to use different assets (graphic, audio, animation etc.) in the development of their game. Encourage them to use assets developed in other units, where possible. Learners should deliver the assignment as a functional computer game with an associated development report.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 14: Computer Games Development

Introduction

Computer games now cover personal computers, consoles, mobile devices such as handheld consoles, phones, tablets and wearable technologies. With the spread of devices available for use, the computer games industry is continually growing and, as such, many computer game developments are as large a production as blockbuster movies, involving many contributors.

As game developers, learners will need to meet client requirements and understand the limitations and potential of different gaming solutions.

Learning aim A – Investigate technologies used in computer gaming

- In learning aim A, learners will investigate computer games, genres and the technologies available to computer game developers. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.
- As learners consider and discuss games, they may start talking about gaming platforms, leading to the popular argument about which platform is best. Try to familiarise yourself with the arguments, so that you can dispel prevailing myths about specific platforms or technologies. Learners could also discuss their expectations of future gaming technologies such as the Xbox One S (released in August 2016), Xbox Scorpio, the PS4 Neo and new developments around the Sony PlayStation VR (released in October 2016).
- As learners discuss games and technologies, you can introduce technologies used in the development of computer games. Learners need to gain knowledge and understanding about the hardware and software options available to game developers.
- If possible, demonstrate some game development technologies with the use of some games in class (whether on PC, console or mobile device). At this stage, it would be useful for learners to see the process of designing and developing a simple game.
- Work with learners to develop their analytical and evaluative skills. Explore different areas of development (e.g. specific consoles, devices or genres of game) and give learners opportunities to consider the requirements of each one.
- Ensure that learners understand how to produce the detail required to achieve the highest grade bands in the assessment.

Learning aim B – Design a computer game to meet client requirements

When delivering learning aim B, you could refer to the popular genres and technologies identified in learning aim A, to help investigate how popular games were designed and how technology was employed. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- You should guide learners in the process of choosing appropriate models to use in their designs. Learners should be familiar with techniques used in game design and confident in applying the ones that they will use in their own designs.

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- In groups, learners could build on earlier discussions to consider the type of games they would like to design. Whether learners do the design work individually or in groups, they will gain useful insight from group discussions.
- Learners must be familiar with software development and the design documentation that is expected of them. They must be able to design the visuals, story, gameplay and algorithms for their game. To this end, they should be confident in the use of storyboards, diagramming techniques and pseudocode.
- Learners should review their designs with their peers and refine as necessary. Learners could present their design concepts for their computer games to the class and ask for comments and suggestions for improvement. They should make a note of any useful feedback given along with details of any refinements required.

Learning aim C – Develop a computer game to meet client requirements

In learning aim C, learners develop their computer game from the designs created in learning aim B.

- Learners must know how to develop software from a design schematic, which should include how to apply graphical rendering and vectoring or add physics to their virtual environments. Learners should be able to produce a prototype of their games using appropriate tools and techniques. They should be able to use several game development environments, so that they can build up their skills.
- Learners should be confident in the use of game engines to develop visual styles. They should be able to optimise for certain input methods, integrate assets and include advanced features such as artificial intelligence, 3D rendering and multiplayer capabilities in their designs.
- Learners should be able to test their computer game for functionality, playability, compatibility and stability. These tests should employ a variety of methods, including white box and black box methodologies. Any issues should be rectified.
- Learners should demonstrate their games to an audience and gather feedback from sample players to identify areas needing improvement and the overall level of acceptance and playability.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they act as users of the system.
- Having completed the process of development, learners should reflect on their performance. They should evaluate their computer game and their own approach to the project.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3: Planning and Management of Computing Projects*
- *Unit 10: Human–Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 16: Object-oriented Programming*
- *Unit 18: Relational Database Development*
- *Unit 22: Systems Analysis and Design*
- *Unit 24: Software Development.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.html5gamedevelopment.com/html5-game-tutorials
  Tutorials for game development in HTML5.
- https://unity3d.com/learn/tutorials
  Tutorials for Unity game engine.
- https://wiki.unrealengine.com/Videos
  Video tutorials for Unreal Engine technology.
- http://sandbox.yoyogames.com/make/tutorials
  YoYo tutorials for game development in Game Maker.

Unit 15: Website Development

Delivery guidance

Approaching the unit

This practical-based unit allows learners to understand the principles of designing and creating a functional website and focuses on the design and development of a website to meet the requirements of a client. Learners should be encouraged to seek out real-life situations where a website is required. For example, learners (or you) could approach local businesses. They could then explore the specific requirements and begin to design and develop a website for that particular business. By utilising real-life scenarios, learners should be empowered to design and develop interesting and creative websites. If this is not possible, you could develop scenarios.

When approaching the unit, it is important to provide practical web-based exercises to hone learners' web design skills. For example, tutorials on hypertext markup language (HTML), cascading style sheets (CSS) and JavaScript® will enable learners to learn the necessary skills involved in developing a website. Learners should be encouraged to explore different software packages – for instance, rapid application development tools such as Dreamweaver. Alternatively, where this type of software is not available, learners should work from a text editor and a web browser.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could start by introducing the principles of website development. Begin with a class discussion that introduces the purpose and principles of website products. There are various concepts that learners need to understand, so there will be elements of tutor-led delivery where key ideas and principles will need to be explained.

The delivery, however, should be predominantly practical-based. Therefore, tutor-led delivery should be complemented with exercises and independent research. Within learning aim A, there is scope for learners to research websites and give feedback on the purpose and principles of website products, as well as the different factors that affect website performance. Learners need to understand that website development is influenced by many factors and this can have a bearing on a website's overall performance and success. Encourage learners to present their research findings through class discussions, via online tools such as blogs or wikis, and as reports.

For learning aim B, there needs to be tutor-led instruction about the design concepts involved in producing websites. Design tools are crucial for showing clients what their website will look like when completed. Failure to produce a coherent design may mean that the end result will not meet the requirements of the client. Therefore, when planning the unit, ensure that learners understand the importance of the design process, and that it should be undertaken in conjunction with the client. If a local employer in your area has the need for a website, try to arrange for a guest speaker to discuss what their needs are so that learners can elicit requirements from them. In addition, try to arrange technical workshops involving staff from local organisations/businesses or opportunities for learners to observe working practice through visits or work experience.

Having discussed the requirements, learners should be able to develop appropriate designs to meet the needs of the client. Teaching and learning should focus on developing each learner's ability to produce clear and coherent designs, and being able to articulate these, as well as highlighting the need for a justification of their choice of design. You should also guide learners to identify the target audience and their requirements.

Learning aim C is a natural extension of learning aim B. Learners must be capable of developing a website to meet the needs of a client. It is important that learners fully understand the different skills required to develop a website and have sufficient practice at applying them. One approach to delivering the content is for learners to work individually through exercises, for example workbook exercises on HTML, CSS and JavaScript®. This will ensure that learners are confident using the necessary skills. Allowing learners to work in pairs may well help them to develop their skills quickly as they will be able to share their existing knowledge with others.

It is important that learners understand how to optimise a website and test its usability, interactivity and compatibility. To help with learners' understanding, they could ask for feedback on their designs from their peers and they could provide feedback for others. Learners should evaluate the feedback and make improvements, as necessary, to meet client needs.

It is feasible that learners will be working at different paces. Their progress will need to be tracked and monitored. Differentiation opportunities are available for learners with prior knowledge: for instance, you could introduce and develop client-side scripting or HTML5.

You could encourage learners to apply the project management skills that they acquired in *Unit 3: Planning and Management of Computing Projects* to their projects.

For learning aim C, you could invite back the guest speaker to appraise the work in progress. This is an opportunity for learners to talk to the guest speaker about what they have developed and for there to be a dialogue between 'designer' and 'client'. This is particularly useful for helping learners to develop their understanding of how to communicate and behave appropriately in more formal situations. The aim is for learners to utilise the techniques they have learned in order to develop an innovative and compelling website for the client. Solving real-world problems will help learners develop employability skills. For example, they will learn the importance of deadlines, communicating appropriately with clients and getting the client to sign off on what they have done. These are all skills that learners will need to develop within the industry during their working lives.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Understand the principles of website development	**A1** Purpose and principles of website products **A2** Factors affecting website performance	A report describing the different types and purposes of websites. This will include an explanation of the factors that affect website performance and mathematical principles used in website development.
B Design a website to meet client requirements	**B1** Website design **B2** Common tools and techniques used to produce websites	Learners' devised design documentation arising from the identification of client requirements. A digital version of the website product, including an observation record sheet and supporting documentation, such as scripts and annotated screenshots, to justify design decisions. A report evaluating the design of the website against the client requirements.
C Develop a website to meet client requirements	**C1** Client-side scripting languages **C2** Website development **C3** Website review **C4** Website optimisation **C5** Skills, knowledge and behaviours	

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Assessment guidance

This unit is internally assessed, so you have some flexibility about what assessment methodologies to adopt. The recommendation is to split assessment into two assignments. The first assignment should focus on the principles of website development and the second one on the design and creation of a website to solve a problem.

The first assignment requires learners to evaluate the principles of website design, and how these can be utilised to produce a high-performance outcome that meets the needs of the client. This could be assessed in a variety of ways, for example in the form of a presentation. Learners could use an online presentation package such as Prezi to present their evaluation to the rest of the class. Assessors could use video recording combined with an observation sheet to cite which assessment criteria the learner has met, with appropriate commentary supporting the reason for awarding a particular grade. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The second assignment should focus on the design and creation of a website. Learners should produce several different website designs, explaining how the finished designs meet the needs of the 'client'. If possible, try to find a real-life scenario for the learners to work on. There should be evidence of appropriate stages in the website design, such as mood boards and wireframes. Learners should produce an evaluation of finished designs against client requirements in a word-processed report. As part of the process, learners could work together on the investigation that will lead to the design and implementation of a website prior to individually designing a solution to the same problem using different creative techniques. Learners could then compare the final outcomes and consider how well they have met the client's brief.

From their designs, learners must produce a fully functioning website that meets the needs of the 'client'. The website must be tested appropriately to ensure that it works and is fit for purpose. Consider different testing methods, such as user acceptance testing or black box testing, for this part of the assessment. Learners could upload their websites to a server for the assessor to mark and use a blog to review their final websites. This would show that different assessment methods have been used creatively within the unit.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 15: Website Development

Introduction

Developing a website can be crucial to any business or organisation. With so many different technology platforms, websites are now more accessible. This, in itself, presents the website developer with more challenges as the website must be equally appropriate across different technologies (such as PC, tablet or smartphone). Therefore, it is extremely important to be able to produce a website that stands out and meets the needs of the client. The ultimate aim of this unit is for learners to understand how websites are developed and for them to design and create their own websites.

Learning aim A – Understand the principles of website development

This learning aim should ensure that learners understand the suitability of websites for their intended audience and purpose. Understanding the principles of website design will help learners develop high-performance websites that meet client requirements.

- You could begin by initiating a group discussion on principles of website development. Note down suggestions on a flip chart or dry wipe board, and discuss each suggested topic in detail.
- Learners could state the different target audiences of websites. This could include social networkers, gamers or buyers. Explain how and why users are now more empowered by websites. Reasons might include the fact that websites are user-friendly, consistent, navigational, flexible and customisable. This could lead into a research exercise in which learners have to explain (and cite examples of) web 1.0 and web 2.0 technologies. There is also scope to discuss the future of website development.
- It is important for you to explain the purpose and principles of website products. Specifically, learners need to understand how to use website design principles to produce engaging websites. You could highlight 'good' and 'bad' websites and cite what principles are being utilised in each case, for example use of white space, typography, colour or consistency. Divide the group into pairs or small groups and ask each group to identify and explore poorly designed websites and compare these with examples of innovative/creative websites. Their judgements should be based on the principles of website design that you have explained.
- Give learners opportunities to do practical-based work. For example, when citing what web 2.0 technologies are, each learner could upload and define a technical term to a VLE glossary. This gives learners a real-life example of how web 2.0 technologies can be utilised.
- Work with learners to develop their analytical and evaluative skills. Explore a variety of different website designs for different purposes and give learners opportunities to consider the requirements of each.

Learning aim B – Design a website to meet client requirements

This learning aim is particularly well suited to learners who want to demonstrate their creative flair and individuality. Give learners practical tasks that ask them to produce different designs to solve a range of problems. Learners need to investigate these problems and develop appropriate designs. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Give direct input to learners about the different ways in which a website developer can design websites, particularly in relation to different future audiences. Use question and answer techniques to check learners' understanding. This should then lead into practical exercises that the learners need to complete.
- Provide each group of learners with a different themed website, for example an information site, a site linked to a sport or other activity, a blogging site or food site. Ask them to work through the appropriate stages of design for their site. This must include mood boards and wireframes.
- Ask learners to present their designs to the rest of the group in the form of a presentation. Consider giving some kind of reward to the group of learners who develop the most innovative design. This should help motivate learners when they do their research and design.
- If possible, enlist the help of a local business with a digital marketing team. Ask if one of their marketers could come in and pose as a client. They should outline why they require a website, and learners could design and develop a website for them. A real-life situation should motivate learners to produce a design of the highest possible standard that meets the needs of their client.

Learning aim C – Develop a website to meet client requirements

Learning aim C should give learners the tools they need to create a website from scratch. Give learners exercises to work through sequentially. Start by teaching the basics, such as how to develop a simple 'Hello World' website, and develop from there.

- Start by leading a discussion on the tools and techniques available to develop websites, linking these to real examples. Explain the software that learners will be using to develop their websites. Learners should explore the advantages and disadvantages of rapid application website development tools and compare them with using a simple text editor.
- When you are confident that learners understand the key concepts involved in designing a website, decide how you wish your learners to create their websites. They could use web authoring tools or code their websites manually using a web browser and notepad.
- It would be advantageous for learners to work through website creation exercises that hone their skills in HTML, CSS and JavaScript®. Exercises should initially be relatively simple such as, for example, developing a basic website, and then progress to harder tasks that challenge learners' creativity. Learners should demonstrate their understanding of website scripting by tracking their progress and you can use appropriate question and answer techniques to check their understanding.
- In the second assignment, learners should actually create a website based on their designs from learning aim B. They will need to optimise their designs, test the website appropriately and review the extent to which it meets the requirements of the client.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they act as users of the system.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3: Planning and Management of Computing Projects*
- *Unit 10: Human–Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 17: Mobile Apps Development*
- *Unit 22: Systems Analysis and Design*
- *Unit 25: Web Application Development*.

The previous QCF Level 3 BTEC National in Computing also has units that link to this and resources produced may be suitable for use in this unit.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Flanagan D – *JavaScript: The Definitive Guide (Definitive Guides), Sixth Edition* (O'Reilly Media, 2011) ISBN 9780596805524
  This is a useful guide on how to use client-side scripting within websites to produce interactivity and ultimately engaging websites.
- McFarland D – *CSS: The Missing Manual, Fourth Edition* (O'Reilly Media, 2015) ISBN 9781491918050
  This is an excellent book on how to use HTML and CSS to produce clean, usable websites.
- McGrath M – *HTML5 in Easy Steps, Seventh Edition* (In Easy Steps Limited, 2011) ISBN 9781840784251
  This book simply conveys how to apply HTML5 scripting to websites easily and efficiently.

Websites

- www.w3schools.com
  The w3schools.com website is a useful starting point for anyone who wishes to learn how to use HTML, CSS and Javascript to produce websites.

- www.codecademy.com
  Anyone can register on the Codecademy website. It includes free videos and training tutorials on how to develop websites.
- https://validator.w3.org
  The Markup Validation Service (W3C) allows you to validate website content for free. This enables you to check for errors and ensure that your website is W3C compliant.
- www.webpagesthatsuck.com
  This website analyses good and poorly designed websites. You may find it useful for showing learners examples when explaining how to design clean, intuitive websites.
- www.csszengarden.com
  The CSS Zen Garden website allows anyone to explore different CSS templates which can be applied to a website design. You could show learners different styles of website layout and how those layouts can be achieved using CSS.

Unit 16: Object-oriented Programming

Delivery guidance

Approaching the unit

The purpose of this unit is to provide learners with practical experience of developing computer programs using an object-oriented language. Learners will investigate the object-oriented programming paradigm before designing and developing their own object-oriented programs.

Learners should have access to adequate integrated development environments (such as those stated in the unit specification) in order to complete the assessments for this unit. Having access to a selection of environments will enable greater opportunity for comparison of the different development options.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could begin with a general introduction to programming by introducing various types of programming language. Learners should gain knowledge of the purpose of programming and some basic principles of software development.

Once learners have a basic understanding of programming, introduce the concept of object-oriented programming, pointing out the benefits that object-oriented programming brings to software development compared with other methods. Learners should be familiar with the concepts of objects, classes and methods. Learners should investigate the specific features of object-oriented programming that are listed in the specification; in particular, encapsulation, data abstraction and inheritance. You should explain the factors that affect performance, safety and security (e.g. platform distribution and memory management) and describe the use of mathematics in object-oriented programming.

It is important that learners understand the mathematical and logical procedures that are the basis of object-oriented programs. You should give learners a variety of object-oriented programs to analyse so that they fully understand these concepts. For example, they could consider the design of algorithms and the use of data structures.

For learning aim B, learners will need to design object-oriented programs. When delivering this learning aim, refer back to the concepts identified in learning aim A. Start by investigating the design of object-oriented programs and discuss how these concepts are used. You should guide learners in the process of choosing appropriate models to use in their designs. They should be familiar with the computational thinking skills that are used in this type of program design and confident about applying the ones that they are going to use in their own designs.

Throughout learning aims B and C, you should ensure that learners understand the stages of software development, including analysis, design (in learning aim

B) and development and testing (in learning aim C). Learners should have knowledge of what is required at each stage of the project and be able to manage its development.

Set aside time for learners to review their designs with their peers. They could do this through presentations or seminars, where they could ask each other questions and make suggestions for improvement.

Allow learners to gain as much practical experience as possible throughout the delivery of learning aim C. Introduce the use of development environments and then allow learners time to experiment with the tools available. Ensure that you give them enough opportunity to develop their skills using their chosen environment so that they can make full use of the constructs, techniques and conventions listed in the unit specification.

In learning aim C, learners will complete their development projects. You should ensure that they are proficient with the development and testing stages of software development.

Allow time for learners to review drafts of their own object-oriented programs and the draft object-oriented programs of their peers. Try to do this late enough that the learners have working programs, but early enough that they will have time to make refinements based on the peer feedback that they receive.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

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Learning aim	Key content areas	Recommended assessment approach
A Understand the principles of object-oriented programming	**A1** Paradigm of object-oriented programming **A2** Factors affecting performance, safety and security **A3** Computational thinking in object-oriented programming	A report explaining the principles of object-oriented programming and their importance, covering languages, libraries and principle features of object-oriented programming.
B Design object-oriented solutions to identified problems	**B1** Designing object-oriented programs **B2** Computational thinking skills applied to object-oriented programming design	A collection of object-oriented programs that demonstrate principles of object-oriented programming and the use of mathematical functions and libraries.
C Develop object-oriented solutions to identified problems	**C1** Developing object-oriented programs **C2** Constructs and techniques **C3** Graphical user interface **C4** Test and review object-oriented programs **C5** Quality characteristics **C6** Skills, knowledge and behaviours	

Assessment guidance

This is an internally assessed unit. The recommended assessment approach is for two assignments.

Assignment 1 should cover learning aim A. The assignment should explain the object-oriented programming paradigm, features of object-oriented programs, factors that may affect performance or security and computational thinking within object-oriented programming. The assignment could be delivered as a written report in any acceptable format. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Assignment 2 covers learning aims B and C. This assignment should be project-based, where learners design and develop their own object-oriented programs. Learners will be expected to develop several programs, each demonstrating selected object-oriented concepts, rather than one program covering all concepts. Learners should present a portfolio of functional object-oriented programs with associated development reports.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 16: Object-oriented Programming

Introduction

In software development, the need for reliable and modular programs is met with object-oriented programming. By the use of object-oriented software, developers can reduce development time, increase productivity, lower costs and simplify the maintenance of software systems.

Learning aim A – Understand the principles of object-oriented programming

- You could begin with an introduction to programming, including a discussion of the general purpose of programming and programming languages. Although this should be kept brief, it will ensure that learners understand the general premise of programming. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.
- To ensure understanding of the purpose of programming, ask learners why software is developed and about the use of programming languages.
- Introduce object-oriented programming with the use of real-world examples. For instance, class Car is a template for a car and an object MyCar is an example of a specific car. There are many other examples that can be used, such as class Fruit, class Animal or class MusicalInstrument.
- It is important that learners understand the benefits of object-oriented programming, the concepts of encapsulation, data abstraction and inheritance, and the features of object-oriented programming, as listed in the unit specification. In particular, it could be linked to the development of computer games with game assets created as objects.
- Wherever practical, highlight the use of computational thinking, such as the definition of algorithms within object-oriented programming.
- Give learners suitable examples to demonstrate performance, safety and security issues, as listed in the unit specification.
- Ensure that learners understand how to produce the detail required to achieve the highest grade bands in the assessment.

Learning aim B – Design object-oriented solutions to identified problems

- Learners should investigate how object-oriented programs are designed and how programming concepts are used. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.
- In groups, learners could build on earlier discussions to consider the type of object-oriented programs they would like to design. Whether learners do the design work individually or in groups, they will gain useful insight from group discussions. This may also be a useful strategy for supporting some of the learners who will find this subject quite challenging.

- Learners must be familiar with software development and the design documentation that is expected of them. They must be able to define program requirements, and to design graphical user interfaces and algorithms for their programs. To this end, they should be confident about identifying a program's requirements, Unified Modelling Language®, diagramming techniques and pseudocode.
- Learners should review their designs with their peers and refine as necessary. Learners could present their designs to the class and invite their colleagues to comment on their suitability. They should make a note of any useful feedback given and details of the refinements required to optimise the design.

Learning aim C – Develop object-oriented solutions to identified problems

In learning aim C, learners will develop object-oriented programs to solve identified problems using the designs that they created in learning aim B.

- Learners must know how to develop software from a design schematic, including how to apply functional requirements and object-oriented concepts to their programs. Learners should be able to produce prototypes of their object-oriented programs using appropriate tools and techniques. They should be able to use several integrated development environments, so that they can build up their skills.
- Learners should draw on the computational thinking skills that they will have developed during learning aim B. This will help them to develop functional programs, to optimise their programs for greater performance and utilise multiple object-oriented concepts, as required.
- Learners should be able to test their object-oriented programs for functionality, usability, maintainability and portability. These tests should use a variety of methods, including white box and black box methodologies, and learners should rectify any issues that the tests identify. Keeping a testing log will also be a useful activity, particularly, as it will contribute to the final evaluation.
- Learners should demonstrate their object-oriented programs to an audience and gather feedback from sample users (for example, others in the class) to identify improvements and the overall level of acceptance.
- Having completed the process of development, learners should reflect on their own performance. They should evaluate their object-oriented programs and the way in which they approached the project. Learners should be taught to see evaluation as an essential part of the personal development process.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 1: Principles of Computer Science*
- *Unit 10: Human–Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 14: Computer Games Development*
- *Unit 17: Mobile Apps Development*
- *Unit 18: Relational Database Development*
- *Unit 22: Systems Analysis and Design*
- *Unit 24: Software Development*
- *Unit 25: Web Application Development.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.cplusplus.com/doc/tutorial
  C++ language tutorials available on the C++ Resources Network (learners need to register).
- https://docs.oracle.com/javase/tutorial
  The Java™ Tutorials are available from Oracle (learners need to download JDK 8).
- www.tutorialspoint.com/index.htm
  Tutorials Point: multiple tutorials are available for many different languages.

Unit 17: Mobile Apps Development

Delivery guidance

Approaching the unit

In this unit, your learners will investigate mobile apps, the devices that they run on and the uses of apps in society. They will then go on to design and develop their own apps to run on mobile devices. As the mobile technology industry is booming and mobile apps are becoming increasingly important to many organisations, you should be able to identify plenty of real life examples, guest speakers and relevant demonstrations to support your teaching.

Learners must have access to adequate mobile app development environments and mobile devices (such as those stated in the unit specification) in order to complete the assessment for this unit. Preferably, learners will have access to a selection of devices and environments as this will give them more opportunities for comparison with development options. You could also consider giving them access to online emulators to enable them to test across a range of situations.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

You could begin learning aim A by discussing how learners use their mobile phones. It is likely that most, if not all, of your learners will have smartphones. Learners could discuss the kinds of app that they use and the different contexts in which they use them. This could lead on to a more general discussion about who uses apps and when and where they use them. Ask learners to consider why designers should ask themselves these questions. You could also ask learners which they are more likely to use: apps that are free, those that are free but have in-app purchases, or ones that they have to pay for. Is there, for example, a maximum amount that they would pay for an app?

Learners will need to have a good understanding of the different types of mobile app that are available (e.g. native, web and hybrid) and how they are implemented and used. When you are introducing the types of app and the contexts of their use, you could include the use of device functions within apps and then move on to talk in greater depth about the way in which apps are integrated with a mobile device and what this means for designers.

Introduce your learners to programming and programming environments for mobile development as early as possible. Allow regular periods of time for them to work with development tools, especially if they have not yet done any programming in their other units. This will ensure that they understand the options available to them and have opportunities to practise their skills before starting work on learning aims B and C.

Throughout learning aims B and C, guide learners through the process of choosing appropriate methods that they could use in their designs. Learners should also be familiar with the different techniques used in app design and be confident in the application of those that they will use in their own designs.

When designing their mobile apps, learners must be aware that, as with any software design, they should understand the scope of the design, and why the scope should be appropriate for the situation (and not be open-ended). They should also understand the importance of documenting this process to contribute to the final evaluation.

As far as possible, learners should consider their project in terms of the stages of software development, including analysis, design, development and testing. Give your learners as much time as possible to gain the practical skills that they will need to use in their own project, and teach them how to use the chosen environment. You should also make sure that they are able to make use of all of the techniques listed in the unit specification.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Investigate mobile apps and mobile devices</td><td>A1 Types of mobile apps
A2 Context of mobile apps
A3 Mobile device integration
A4 Mobile app programming</td><td>A report evaluating bespoke mobile apps running on different mobile devices. An analysis of mobile device functions and the context in which mobile apps are used and an evaluation of the effectiveness of the implementation of mobile apps.</td></tr>
<tr><td>B Design a mobile app that utilises device functions</td><td>B1 Requirements for an app
B2 Designing a mobile app</td><td rowspan="2">Analysis, design and development of a mobile app. An analysis of context. Product design documents, including justification of decisions made. A log of the development process including optimisation, annotated code, screenshots of running app or demonstration of app running on a mobile device. Testing documentation, including a test log, log of errors and any resolutions made. An evaluation of the design and completed app including demonstration of responsibility, creativity and self management.</td></tr>
<tr><td>C Develop a mobile app that utilises device functions</td><td>C1 Content preparation for mobile apps
C2 Developing a mobile app
C3 Testing a mobile app
C4 Lessons learned from developing a mobile app
C5 Reviewing own skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This unit is assessed using two assignments: one covering learning aim A, and one covering learning aims B and C.

The first assignment should ask learners to analyse mobile apps and the devices that use them and to discuss how the requirements of an app influence its design. They should also discuss the technology available in mobile devices and the impact that this has on the design and implementation of mobile apps. Learners should investigate at least one app that is implemented across multiple platforms (e.g. available on both Android® and Apple® devices). This could take the form of a written report, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The second assignment should ask learners to design and develop their own mobile apps. Learners will need to prepare their content (graphics, audio etc.) for use on their targeted device and they should be encouraged to use assets developed in other units where possible. By the end of the project, learners should have produced a functional mobile app with an associated development report, including justification for design decisions and an evaluation of the finished product.

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 17: Mobile apps Development

Introduction

Mobile devices are prevalent in our society, with many people possessing several, and the mobile technology industry is still growing. Nowadays, many software developments must be compatible with mobile devices. Almost all public-facing companies and organisations have an app for their customers.

As mobile app developers, your learners will need to analyse the device functionality required by apps and the capabilities of mobile devices. This will give them an understanding of the potential and the limitations of different mobile solutions.

Learning aim A – Investigate mobile apps and mobile devices

- As learners need to have knowledge of several implementation options, you should give them examples of mobile devices of different types (e.g. phones and tablets, different operating systems or different makes and models of device).
- Learners must understand the process of designing an app for use on a mobile device. Give them examples of good practice and case studies for development of mobile apps. You could discuss how developers discover the need for an app, what the type and the context of the app would be and how the functions of the device would be used. In a wider context, learners could be canvassed for their opinion about whether some apps could be considered risky (for example apps that provide medical diagnosis or which claim to provide advice and therapy to help users manage their mental health). You should include a discussion about how plans are initiated and what should be taken through to the design stage (covered in learning aim B).
- Demonstrate some examples of mobile device functions, such as accelerometers, global positioning systems (GPS) and apps that can read ambient temperature. This is an opportunity to discuss apps in relation to wearable technologies such as Apple® watches, or the application of apps in the development of 'Hive®'. Discuss with learners how different apps might use these functions in different ways, and the implications that these functions have for the design and development of mobile apps. It would be beneficial for learners to have access to devices with the functions that you demonstrate and discuss, so that they can investigate the uses of each function.
- Work with learners to develop their analytical and evaluative skills. Explore a range of different devices and give learners opportunities to consider the requirements of each one.

Learning aim B – Design a mobile app that utilises device functions

To help learners to understand the theory behind mobile apps in context, you could refer to the apps, devices and functions identified in learning aim A. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- In groups, learners could build on earlier discussions to consider the types of app that they would like to design. Group discussions will help to generate ideas and give learners useful insights, even if they will ultimately work individually on their projects.

- Learners must be familiar with software development and the types of design documentation that they will need to produce and should understand the importance of documenting any design and development activity. Give learners real or fictional examples of the design process and documentation, and talk through the different stages of the process and the different features of the documentation.
- Learners will need to design the purpose, interface and algorithms for their app. To this end, they should be confident in the use of diagramming techniques and pseudocode. To build their confidence, learners could investigate an app that is widely available and produce design diagrams and pseudocode to describe the app.
- Learners should present their designs to their peers for review, refining their designs as necessary in response to constructive feedback. This activity could be done a number of times throughout the design process, and you could organise it as a *Dragon's Den*-style pitch or as presentation-and-feedback sessions.

Learning aim C – Develop a mobile app that utilises device functions

- Give learners a sample of a design schematic and demonstrate some of the steps in developing software from the schematic.
- Discuss what is meant by 'evaluating the effectiveness' of an app. You could get learners thinking about this by choosing an app that is widely available and identifying the requirements that it should fulfil. You could then ask learners to evaluate its effectiveness against these requirements.
- Ask learners to present prototypes of their apps to a small audience, perhaps as a small-group task. They should use appropriate tools and techniques for their app, such as programming constructs, event handling and device capabilities. Make sure that learners also have plenty of time to review their own apps and those of their peers. This should be done late enough in the development for learners to have a functional app, but early enough for them to have time to make refinements based on the feedback they receive.
- Learners should understand the benefits and limitations of mobile devices in terms of effective preparation of content. This should be related to specific devices. You could put learners into groups where they will discuss a particular device or type of device (e.g. Apple iPhone devices or Samsung Galaxy devices) in terms of its benefits and limitations. Each group could then present their findings to the other groups.
- Learners should test their mobile app for functionality, compatibility, usability, performance and acceptance. Their testing should go beyond their own testing activities or using learners in their group to test their apps. They should perform these tests using a variety of methods, such as white-box testing and black-box testing. They should rectify any issues that arise from these tests.
- As the development process continues, learners should demonstrate their app to a larger audience and gather feedback from sample users to identify improvements and the overall level of acceptance. This could form the basis for their evaluation of their app with regard to requirements and user feedback.
- Throughout the learning aim, ask learners to self-reflect on their performance and their overall approach to the tasks that they complete. You could encourage them to use tools such as SWOT analysis to identify their strengths and any areas for improvement.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 10: Human-Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 14: Computer Games Development*
- *Unit 16: Object-oriented Programming*
- *Unit 18: Relational Database Development*
- *Unit 22: Systems Analysis and Design*
- *Unit 24: Software Development*
- *Unit 26: Programmable Devices and Controllers.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- http://developer.android.com/index.html
  Android development portal.
- https://developer.apple.com
  Apple iOS development portal.
- https://dev.windows.com/en-us
  Microsoft Windows development portal.

Unit 18: Relational Database Development

Delivery guidance

Approaching the unit

This unit helps learners to understand the concepts and processes relating to the storage of data. Learners will discuss how data is maintained and kept relevant, and why data storage is necessary. They will investigate relational database management systems (RDBMSs), how they are used and how they are developed, before producing their own relational database.

Learners should have access to an adequate RDBMS (such as those stated in the unit specification) in order to complete the assessments for this unit.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

You could begin learning aim A with a discussion about data storage (for example, who needs to store data and why they need to) and what kinds of data need to be stored in different contexts.

This unit will enable learners to become familiar with relational data structures. You should introduce RDBMSs and the environments they are suited to. Give them access to plenty of examples of their use in order to build their confidence with the components.

Learners must also understand how data and data structures can be manipulated within an RDBMS and why it might be necessary to perform such manipulations.

Explain to learners the process and stages of normalisation. Give practical examples of normalisation and demonstrations of data in various normal forms. This is a concept that learners may struggle with, so scenarios given as homework tasks will help to embed the learning (you can download examples of forms as images from search engines that learners will be able to use for practice).

Learners should be confident about the process of manipulating data, data structures and normalisation so that they are fully prepared and ready to work through learning aims B and C.

In learning aims B and C, learners need to design and develop their own database solution using a selected RDBMS. They must understand the options that are available – make sure that you introduce learners to an RDBMS early to allow plenty of time for them to practise using their newly acquired skills.

As with any software design, learners need to be familiar with the scope of the specification when designing their relational database solution. Guide learners in the process of choosing appropriate methods to use in their designs. Learners should be familiar with the techniques used in database design and be confident in applying the ones that they will use in their own designs. Although the main focus of this unit is on the ‘back end’ of a database, learners should be able to design a functioning user interface for their database solution. Simple designs can be hand drawn or digitally created.

When discussing the design specification, it is important to consider the legal and ethical impacts on the storage of data, especially if the data is sensitive (e.g. medical records). Make sure that learners are aware of relevant legislation in England, Wales and Northern Ireland.

When you are delivering learning aim B, spend some time emphasising the importance of planning a project before implementation. Explain how important it is, when reviewing and refining designs, to respond positively to feedback from others and to always be professional when dealing with clients in order to meet their requirements. Learners must understand that there will be times when a customer may have specific ideas or requirements which cannot be technically met because they could compromise the integrity of a database. They should accept that as technical experts they may well have to explain the reasons why to non-technical users.

Throughout this learning aim and learning aim C, impress on learners that software development involves different stages, which include analysis, design (in learning aim B), development and testing (in learning aim C). Make sure that learners know what is required in the analysis and design of a database solution and the management of a software development project. You should make sure that they have plenty of time to experiment with the necessary tools.

You should instruct learners about the use of the chosen RDBMS, making sure that they are confident when using the techniques listed in the unit specification.

In learning aim C, learners should complete their development projects. Make sure that learners are proficient with the development and testing stages of database development and are able to review and optimise their database solutions effectively.

Allow time for learners to review their database solutions and the solutions of their peers. Ensure that learners have had some input from you regarding giving feedback and critiquing other learners' work to ensure that this is a supportive and not a confrontational process. This should be done late enough that the learners have a functional database, but early enough that they have time to make refinements based on the feedback they receive.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Examine the purpose and structure of data storage in relational database management systems</td><td>A1 Relational database management systems
A2 Manipulating data structures and data in relational databases
A3 Normalisation</td><td>A presentation or report explaining data storage and structures, the process of normalisation and the advantages of using relational database systems.</td></tr>
<tr><td>B Design a relational database solution to meet client requirements</td><td>B1 Relational database design techniques and processes
B2 Design documentation
B3 Reviewing and refining designs</td><td rowspan="2">A practical activity involving the design and development of a relational database to fulfil identified client requirements.
Evidence will include a project brief, design documentation, development and testing logs and meeting notes. A report that evaluates the effectiveness and appropriateness of the relational database and suggests ways in which solutions could be improved and/or alternative solutions that could be used if the task were to be repeated.</td></tr>
<tr><td>C Develop a relational database solution to meet client requirements</td><td>C1 Producing a database solution
C2 Testing the database solution
C3 Reviewing the database solution
C4 Optimising the database solution
C5 Reviewing own skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This unit is internally assessed by means of two assignments.

Assignment 1 should cover learning aim A. It should explain data storage and structures, normalisation and how it is achieved, and the advantages of using RDBMS. Learners should either produce a report or deliver a presentation. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Assignment 2 covers learning aims B and C and it should be practical and project based. Learners should design and develop a relational database solution to meet 'client' requirements. You could give learners a case study to review and then ask them to design a database that is fit for purpose. Learners should produce a functional database with an associated development report.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 18: Relational Database Development

Introduction

Almost all organisations require data storage, as do most software applications. Databases vary considerably in their complexity, but all have the same principle – data should be stored and retrieved as needed. Data is stored in tables and can be queried with structured commands.

Learning aim A – Examine the purpose and structure of data storage in relational database management systems

In learning aim A, learners investigate databases and RDBMSs.

- Learners need to understand the purpose of databases, how they organise data, and how data is inserted and retrieved. Cover these concepts briefly at the start of learning aim A – you can expand on them as the unit progresses.
- Give practical demonstrations and examples of normalised relations. It would be beneficial for learners to have sample data to review as you discuss normalisation. That way, learners can discuss the implications that normalisation has for the data stored.
- Learners should work through normalisation exercises involving the identification of attributes which progress through the stages of normalisation to 3NF. Learners could work in groups and present their solutions to the class to show different interpretations, which will allow learners the opportunity to justify their decisions.
- Introduce learners to a range of RDBMS options and structured query language (SQL). Allow time for learners to work with the development tools regularly throughout the unit. Learners should build their confidence and skills in using SQL to create, modify, populate and query a database.
- Work with learners to develop their analytical and evaluative skills. Explore different work-based contexts and give learners opportunities to consider the requirements of each scenario.

Learning aim B – Design a relational database solution to meet client requirements

When delivering this learning aim, refer to the concepts identified in learning aim A.

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Ensure that learners are familiar with the techniques used in database design and are confident in applying the ones that they will use in their own designs.
- Learners should review the concepts that were covered in learning aim A in order to consider the database that they would like to design. Whether learners work individually or in groups, they will gain useful insight from group discussions.
- Learners must be familiar with software development and the design documentation that is expected of them. They must be able to design the data structure and application and show an awareness of legal and ethical issues on their database. To this end, they should be confident about using the necessary diagramming techniques related to data design, such as entity relationship

diagrams. Opportunities to develop these skills are essential • Learners should be able to develop plans for the review of their designs. They should be able to develop feedback forms, select test users and structure their communication with clients.
Learning aim C – Develop a relational database solution to meet client requirements
In learning aim C, learners will need to develop their databases from the designs that they created in learning aim B. • Learners must know how to develop a database from a design schematic. They should be able to develop and populate their databases using appropriate tools, such as SQL. • Learners should be able to test their databases for referential integrity, functionality, security and stability. They should perform the tests using a variety of methods and any issues that are identified should be rectified, as appropriate. • Learners should demonstrate their databases to their peers and gather feedback in order to identify where improvements are needed and gain an idea of the overall level of acceptance. • Learners should consider their options for the techniques that they could apply in order to optimise their databases. They should include an analysis of the benefits and limitations of each of these options. • Having completed the process of development, each learner should reflect on their own performance in order to evaluate their database and their own approach to the project. • It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback. • Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 14: Computer Games Development*
- *Unit 16: Object-oriented Programming*
- *Unit 17: Mobile Apps Development*
- *Unit 22: Systems Analysis and Design*
- *Unit 23: Systems Methodology*
- *Unit 24: Software Development*
- *Unit 25: Web Application Development*
- *Unit 31: Large-Scale Data Systems*
- *Unit 32: Business Process Modelling Tools.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Connolly T and Begg C – *Database Systems: A Practical Approach to Design, Implementation, and Management, Sixth Edition* (Pearson, 2014)
  ISBN 9780132943260
  This is a comprehensive guide to database systems and management.

Websites

- https://docs.oracle.com/cd/E11882_01/server.112/e40540/toc.htm
  Database concepts from Oracle.

Unit 19: Computer Networking

Delivery guidance

Approaching the unit

This unit will allow your learners to acquire the important practical skills that are required to design, implement and test computer network infrastructure used for work, communications and entertainment. They will learn how to install and configure the networking hardware and software used to build and configure computer networks, and they will develop a solid understanding of the underlying standard networking protocols, install them and test their operations.

Computer networks are at the heart of the infrastructure of modern successful business operations. Using new and innovative computer networking models strengthens the competitiveness and agility of businesses and their ability to grow and expand. Your learners will acquire the knowledge, and develop the technical and practical skills necessary, to support and manage computer networks. These valuable skills will enable learners to progress into further and higher education or pursue one of the many careers in network support.

It is essential that learners get first-hand experiences of network implementations, by exposing them to real-world networking infrastructure used in as many real organisations as possible. This could be achieved by planning visits to related professional exhibitions and business parks, and organising seminars and talks in which employers and IT professionals are invited to participate.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, although its content areas focus on researching and investigating the building blocks of computer networks, it is important to get your learners to do some practical work and have access to computer networks. They should be encouraged to experiment with different hardware and software components, using systematic and gradually more demanding exercises. Learners should work in small groups and keep records of the outcomes of their work, including planned or unplanned problems that are likely to arise from this type of practical work.

Learners should be given research tasks, using the internet or the learning resource centre, that will encourage them to investigate the underlying networking protocols and services. To help your learners build a sound understanding of this potentially difficult area, they need to have access to a range of different learning tools and techniques to see these protocols and services in action. You could use animated demos and introduce tools that give learners the ability to see these protocols and service interactions (for example, packet sniffers, protocol analysers, performance monitors and some of the many troubleshooting tools and techniques used in the field of computer networking).

Gaining a professional academy status, for example Cisco Networking Academy or Microsoft IT Academy, would offer some valuable teaching and learning resources, as long as learners are made aware of the marketing nature of these academies and their relationship to specific vendors (in this case, Cisco systems and Microsoft Corp.).

By the time you begin delivery of learning aim B, learners should be familiar with computer network hardware, software and services. They should have completed the report for the first assignment and be ready to investigate network design issues. For this aim, you need to make sure that your learners are familiar with the process of designing and implementing a computer network. Introduce your learners to the most widely used design strategies. Essentially, they need to learn that, for any design strategy to be successful, it needs to follow a number of stages, and relate to predetermined client requirements.

Make sure that learners are familiar with the design process and procedures by showing them examples of scenarios. You could get learners to work in small groups to produce design proposals and then present them to the rest of the class, justifying their design choices. Make sure that learners' design proposals include physical and logical characteristics and use appropriate illustrations, tables and diagrams, along with listings of their selected components and the services they plan to implement.

In small groups, learners could devise an implementation plan using project-planning techniques. They should create a schedule, in a Gantt chart format, to identify the development stages of their design proposal, which should include the collection of testing data.

For learning aim C, your learners will need to develop the computer network according to given specifications based on client requirements. Essentially, this aim consists of systematic practical activities that allow the learners to use all of their skills and knowledge to produce a fully functioning computer network. Learners will then need to collect and discuss test results accordingly, and evaluate these against the initial specifications. They will need to have access to the necessary minimum hardware and software components required by their design proposal. Learners can use physical and/or virtualised environments to install and configure the hardware and software components, implement the networking services and test connectivity, as planned.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Investigate how computer networks use networking communications protocols to provide effective and secure access to networking services and resources</td><td>A1 Network types and models

A2 Network components

A3 Network communication standards and protocols

A4 Networking infrastructure services and resources</td><td>A report explaining the types and characteristics of computer networks, the need to use networking standard protocols, and the networking hardware and software components to provide secure access to the networking services and resources.</td></tr>
<tr><td>B Investigate computer network design, to meet client requirements</td><td>B1 Network design strategies and architectures.

B2 Network development planning

B3 Network services and resources access</td><td rowspan="2">Learner-devised design documentation including network diagrams and addressing scheme table arising from the identification of client requirements.

Notes covering network design strategies and network development planning.

Photographs and screenshots of network development, configuration testing, and troubleshooting and optimisation, supported by assessor's observation or witness statement.

An overall report evaluating and reviewing the design and implementation stages.

Diary notes, witness testimony, audio/video recorded discussion demonstrating skills, knowledge and behaviours.</td></tr>
<tr><td>C Develop a computer network to meet client requirements</td><td>C1 Network implementation and configuration

C2 Network testing and troubleshooting

C3 Network performance monitoring

C4 Evaluation and review of network design

C5 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

In this internally assessed unit, learners will be assessed by means of two assignments.

The first assignment assesses the learners understanding of the reasons why there are so many diverse types and models of computer networks (for example, peer-to-peer, client/server, internal infrastructure or cloud based). Using examples and scenarios, learners should explain and evaluate how each type satisfies the networking needs of different organisations, from a simple SOHO (small office home office) network to infrastructure used by medium and large enterprises. Learners are also required to produce an explanation of the networking hardware and software components and an analysis of their corresponding functions. This could take the form of a written report, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The second assignment assesses two major areas: the learners' ability to produce a network design specification based on a given set of client requirements, and the learners' technical and professional ability to develop the actual network itself, test its functionality and evaluate it against the initial requirement, proposing further improvement, as necessary. Essentially, this assessment tests each learner's ability to use the hardware and software made available to them, within the classroom environment, to design and build a client/server network based on realistically achievable requirements.

978-1-446-92831-8 – Pearson BTEC Nationals in Computing – Delivery Guide

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 19: Computer Networking

Introduction

The aim of this unit is to enable learners to design, implement and support suitable computer networks.

Learning aim A – Investigate how computer networks use networking communications protocols to provide effective and secure access to networking services and resources

This section will require learners to undertake extensive research into the need for different types of computer networks and their applications and services. This should include the networking hardware and software and the networking standards and protocols. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Working in small groups, learners should produce a list of networking applications and services, and then discuss their advantages and disadvantages.
- In small groups, introduce your learners to a good range of networking hardware and software. They could be given a number of tasks and activities to:
    - build basic peer-to-peer network computer network by connecting two computers or more together
    - use wired and wireless connection media
    - test their connectivity
    - create users
    - share files, folders and printers
    - set access permissions
    - test accessibility to network resources
    - troubleshoot planned or unplanned problems, and document test results.
- With the help of animated demonstrations and activities, you should introduce learners to the networking protocols, which they will need to investigate, research and discuss. These should include:
    - the OSI seven layers and their functions

      the TCP/IP protocol suite including the protocol used at each layer to provide essential networking services, at minimum DNS, DHCP, HTTP, TCP and IP
    - the Ethernet protocol suite, including the 802.3 and the 802.11x.
- To reinforce understanding, introduce learners to software tools (e.g. Wireshark*) to investigate the communication between computers and the way in which transmission protocols are used to establish and maintain connectivity and communication.
- Working in small groups and using classroom activities, learners should:
    - experiment with at least two different network protocol analysers and learn how to install and use their functions

  - use network analysers to observe how networking protocols are used to link computers and provide services.
- Learners should upgrade their peer-to-peer network to a client/server infrastructure by:
  - installing a server OS
  - implementing basic networking services at minimum AD, DNS, DHCP and file services
  - creating users and groups
  - implementing a password policy
  - testing, troubleshooting and documenting results.
- You should give learners a number of client requirement scenarios. Learners should then work in groups to produce class presentations that compare and contrast different computer network models and evaluate their benefits in relation to meeting client requirements.

Learning aim B – Investigate computer network design, to meet client requirements

In this learning aim, introduce learners to network design strategies and implementation planning. This builds on the research and activities that learners carried out in preparation for the first assignment. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. Using business scenarios, learners should work in groups to complete the following activities.

- Learners should discuss network design strategies and the factors, such as business goals and technical requirements, that need to be taken into consideration.
- Learners should discuss design aims (e.g. scalability, availability and security) and design constraints and trade-offs (e.g. budget, time and environmental factors).
- Ask learners to produce and discuss physical and logical designs to meet given scenarios.
- Introduce your learners to design and prototyping software to produce IP addressing tables and networking diagrams to represent network design.
- Ask learners to produce and discuss the networking services required to access and share resources. This should include:
  - design of directory services
  - design of user and group permissions
  - password and audit policy proposals
  - access permissions for files and folders.
- Using the design scenario, learners should produce a plan of implementation, including the required hardware and software, the implementation schedule, network development planning and access to network services and resources.

Learning aim C – Develop a computer network to meet client requirements

This aim is about giving your learners opportunities to develop their practical skills to implement and develop the planned network design, test it and evaluate its functionality against client requirements.

- Learners should use classroom resources to:

- connect the selected networking hardware
- install and configure system software and any planned applications
- install the planned networking services
- create the planned users and groups and allocate permissions accordingly
- create and configure the planned network resources (files, folders and printers)
- test network connectivity and functionality of services
- test permissions for users and accessibility of resources
- document all test results and troubleshooting activities
- evaluate the results against specified requirements
- propose enhancement to improve network availability and security.

- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 20: Managing and Supporting Systems*
- *Unit 21: Virtualisation*
- *Unit 29: Network Operating Systems*
- *Unit 30: Communication Technologies*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Denise D and White R – *The Art of Network Architecture: Business-Driven Design* (Cisco Press, 2014) ISBN 9781587143755
  This book guides network designers in asking and answering the crucial questions that lead to elegant, high-value solutions, blending business and technical concerns.
- Thomatis M – *Network Design Cookbook: Architecting Cisco Networks* (lulu.com, 2015) ISBN 9781257750245
  This book provides valuable resources and tools for network design, constructing topology and services with step-by-step design assistance for many solutions such as Lan, Wan, Data Center, Internet Edge, Firewall and Collaboration.
- Minasi M, Greene K, Booth C, Butler R, McCabe J, Panek R, Rice M and Roth S – *Mastering Windows Server 2012 R2* (Sybex, 2014) ISBN 9781118289426
  This book covers new features and functions of Windows Server and includes real-world scenarios to put them into perspective.
- Cisco Networking Academy – *Introduction to Networks: Companion Guide* (Cisco Press, 2013) ISBN 9781587133169
  This book introduces the architecture, structure, functions, components and models of the internet and computer networks, including the principles of IP addressing and fundamentals of Ethernet concepts, media and operations.

Websites

- www.wireshark.org
  The Wireshark team. From this website, you can download the Wireshark software, which is a free and open-source packet analyser. It is used for network troubleshooting, analysis, software and communications protocol development and education. You can also find guides to help you start to use these very useful software tools

- http://freevideolectures.com/Course/3162/Computer-Networking-Tutorial Computer Networking Tutorial. This website includes a number of video tutorials covering a wide range of computer network topics and concepts.

978-1-446-92831-8 – Pearson BTEC Nationals in Computing – Delivery Guide

Unit 20: Managing and Supporting Systems

Delivery guidance

Approaching the unit

This is a practical unit that will particularly appeal to learners who are interested in pursuing a career in IT system support. In this respect, the unit is closely linked to the specific job role of IT support technician.

To deliver and assess the unit, learners will need access to a mock-up of a simple IT system, including a server, end-user computer and networking infrastructure. Learners should be able to use physical or virtualised systems. Learning aims A and B give plenty of opportunities to involve IT managers or technicians from local businesses or your own school/college. Most learners will have had experience of 'managing' their own computer but it is important to emphasise the differences, both in levels of complexity and the conflicting demands, between home and commercial systems. Bear in mind that quite a lot of resources will be needed for the practical aspects of the unit. Make sure that you plan ahead so that you can have everything set up in good time. Learners will require access to computer hardware and software that they can use to build their network systems. This includes access to a computer that can be used as a server, several client computers and networking hardware such as a switch, router and a wireless access point. Computers can be real or virtual.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

A good way to start the unit, and learning aim A, is by considering what the roles of IT support technician and system manager actually involve. Learners will probably have some ideas about this, but it is an ideal opportunity to ask a system manager or technician from a local business to come and speak to the learners. They can give real-life examples of what the role involves and talk about the challenges they face on a day-to-day basis.

Topics A3 and A4 are about the tools that IT technicians use to manage systems and user support requests. Again, guest speakers can give up-to-date, real-life information about these topics. Learners may also find it useful to visit an IT support department, if this is possible. The experience of seeing how these tools are actually used is much more valuable than just reading about them. Also, be aware that this is quite a fast-moving area, with new versions of server and desktop operating systems released regularly, and new tools and ways of supporting users are being developed all the time. In addition, make sure that any information that learners access from the internet is up to date.

Learning aim B involves learners planning and setting up the mock-up of the system that they will support and manage. This includes planning the user support request system, the standard user desktop and the network infrastructure for the system. Learners also need to plan the escalation procedures, the service level agreement and the security policies that will apply to their system. You need to provide a scenario for their mock-up system – input from any contacts that you may have in the industry would help here.

In learning aim C, learners manage and support the system that they planned and set up for learning aim B. Learners need access to systems on which they can practise the required skills. It will not be possible to carry out the required set-up and configuration on the live computing systems within your centre, so you have two options.

- You could have separate, dedicated, unrestricted computer systems, which are not connected directly to the main college/school system.
- You could use virtual PCs. A number of software products allow you to install a software-emulated virtual PC. VirtualBox is open software and free.

Learners also need to run a simulation of the support request (helpdesk) system. You will need to collect sufficient, realistic user support requests to provide the input to the system. Once again, local business contacts or your own school/college technicians might be able to help, for example, by giving you an idea of the most common user support requests.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Investigate common IT system management and support tools	**A1** Live system management **A2** System maintenance and disaster recovery **A3** System and network management tools **A4** Managing user support requests	Written report or blog. Audio or video recorded discussion on the activities and tools used to manage and support an organisation's IT system.
B Design the management and support infrastructure for a networked IT system to meet an organisation's requirements	**B1** Plan management and support procedures **B2** Plan user desktop interface **B3** System planning	A plan for managing and supporting an IT system to meet a client's requirements, accompanied by supporting development and testing documentation. Diary of activities carried out, supported by screenshots and photos, observation reports and audio or video recordings of user feedback. A report evaluating the systems management and support procedures against the client's requirements.
C Carry out management and support activities on a networked IT system	**C1** Support activities **C2** System management and implementation activities **C3** System optimisation **C4** Skills, knowledge and behaviours	

Assessment guidance

This is an internally assessed unit and learners will need to complete internally devised and marked assignments to cover the learning aims.

Learning aim A is theoretical in nature and the assignment scenario should be based around a real or fictitious organisation. Evidence could be in the form of a written report, blog, wiki or be audio/visual, provided the information is communicated in a clear and detailed manner using appropriate language.

Learning aims B and C should be assessed together. Learning aim B requires learners to produce a plan for the management and support of a system. Give learners a scenario with sufficient detail for them to meet the assessment criteria. For example, they need to be given requirements for the user desktop (applications, network connections, settings etc.), support helpdesk, disk space, data storage and network infrastructure. For learning aim C, learners will implement their plans and carry out support activities on a networked system.

Each learner will need to provide a portfolio of evidence showing that they planned the support and management of the system, and they need to justify their choices. They also need to provide evidence that they have managed and supported the system. This is likely to comprise a variety of evidence types, including photographs, screenshots and printouts of the user support database test plans. A diary format may be a good way to present the evidence. A daily diary of, for example, activities, problems and solutions is likely to prove useful when learners come to evaluate the whole process.

Learners also need to obtain feedback from others in order to optimise and evaluate their system. This feedback may come from other learners or perhaps an external professional such as a system manager. Ensure that the feedback is recorded in some way – preferably as an audio or video recording, but a written witness testimony is acceptable. Learners need to show clearly how they have used the evidence and feedback from testing to optimise their system. The optimisation work they do could be in terms of usability, supportability, security or performance of the system.

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Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 20: Managing and Supporting Systems
Introduction The key to making this unit a valuable learning experience is to relate the content, as far as possible, to what happens in the management and support of a real-life IT system. Guest speakers and visits will help. While certain compromises will have to be made, the mock-up system that learners will create should help to develop a good understanding of how systems are maintained and supported in reality.
Learning aim A – Investigate common IT system management and support tools
Most learners will have some experience as a user of an IT system, both in college/school and at home. A good starting point would be to discuss their experiences of the support they received. Some of it may not be positive, but you could discuss why this might have been and how the support could have been better. Remind learners that one day soon they might be at the other end of the phone (or email)! Remembering this discussion might be helpful much later on in the unit when learners evaluate the system they set up. Taking notes will help to ensure that they have something to refer back to. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● Learners could start by considering what a typical day in the life of a system manager might entail, and what sort of tasks they might find themselves doing. They should investigate some of the unforeseen challenges by interviewing individuals working in these roles, and interviewing the system manager for their centre would be a good starting point. Learners may need some guidance, but if you can follow the activity up with a visit by a system manager from a local company then they can find out from first-hand experience what managing and supporting a system actually involves. You might want to brief learners about the type of company the speaker is coming from (for example, size, number of IT users or typical applications). Make sure that you also brief the speaker and that learners have a reasonable number of questions prepared in order to make the most of the session. Remember to encourage the learners to take notes. ● Work with learners to develop their analytical and evaluative skills. One of the key issues with analysis is trying to avoid assumptions and preconceptions – just because something has been this way once, does not mean that it will be this way next time. Explore different work-based contexts and give learners opportunities to consider the requirements of each scenario. ● Network/IT codes of practice can be a fairly dull topic, but learners might not be familiar with (or do not remember!) what your centre's says. Have a look at it, and ask learners to source a few other codes of practice from the internet. Ask them what they think about the code of practice and what they might change about it if they were system managers. In essence, learners should be encouraged to see codes of practice from both sides (organisation and user). Then suggest that they try to draft their own version. Remind learners of the need to balance user freedom with the need for the system manager to keep the system secure and functional for everyone. Remind them that if things go badly wrong, the system manager's job is on the line. Bear the results of these discussions in mind for visit/guest speaker

questions.

- Setting up an IT helpdesk system is an important part of this unit. If possible, arrange for learners to have a real helpdesk system demonstrated to them (or even better, see if you can arrange for learners to spend a day or more working on one). The IT technicians at your school or college may use a computerised helpdesk system and you should be able to arrange for a demonstration. It would also be beneficial for learners to gain exposure to a more commercial system, so a visit to a local company that runs a reasonably sized IT system would be ideal. This would also give learners the opportunity to see other support tools in use. There is also an opportunity to investigate helpdesk services provided through social media such as Facebook (Apple Support is one example; Virgin Media Technical Support is another).

Learning aim B – Design the management and support infrastructure for a networked IT system to meet an organisation's requirements

One of the first tasks in this learning aim is to set up the user support request (helpdesk) system. This could be done by installing one of the open software licence systems that are available (such as OTRS Free). Alternatively, the learners could develop their own helpdesk database in conjunction with another unit (such as *Unit 18: Relational Database Development*). Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Service level agreements (SLAs) and escalation procedures are important but not very exciting topics to cover. Encourage learners to think about the conflicting demands that these procedures attempt to balance (users want their computer fixed as soon as possible, but resources may be limited). One way of emphasising these demands is get learners to work in small groups, with some of them taking the role of users (who want their computers fixed fast) and others taking the role of the IT managers with a limited budget to spend on support. Ask learners to debate the kind of SLA that will achieve a reasonable balance. They should also discuss and explore the complexities of managing user expectations.
- To develop a standard user desktop interface, learners will need to follow a simple scenario. This should list the applications and settings that are required. It is common practice in IT support to give users a standardised desktop and applications, which they are, normally, not allowed to change. Standard applications include things like mapped drives, desktop colours and background (often including the company logo). Learners need to set up the standard desktop and then test that it works as expected before an image file is made for installation on all the user computers at the case-study company (this final step is completed during learning aim C).

Learning aim C – Carry out management and support activities on a networked IT system

The main task in learning aim C is to set up the IT system and maintain/support it. This, of course, is a simulated activity but, with a little effort, a fair degree of realism should be possible. The system needs to have a server and at least one user computer, and these can be real or virtual systems. Learners will need to follow a scenario that includes details of the users and groups, shared folders and so on that need to be set up.

- Learners should attempt to run a simulated helpdesk. They should use the help desk software that they installed and set up in learning aim B. The key requirement for this activity is the availability of realistic helpdesk requests for the learners to deal with. With some imagination, these can be invented, or you may be able to get some ideas (if not actual helpdesk requests) from local businesses that run an IT

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helpdesk, or your own centre's system.

- With a mock-up system, it may be difficult to get enough usage of the system to be able to do much in the way of meaningful optimisation. However, if learners work in small groups they could manage one system and play the role of users for another system. Encourage the learners acting as users to test out the system thoroughly. This will allow them to give each other feedback on the system and will probably also create some real support issues. Remind learners to report the issues and follow them up using the helpdesk system.
- To obtain higher grades it is important for learners to develop the skills to be able to evaluate the system and optimise it, from the perspective of management and support. This is something that they should be encouraged to explore with the guest speakers, as it is important that they develop a professional perspective on the issues rather than that of a home user. In setting up, managing and optimising their system, it is important that you make learners aware that they are practising the skills that they will require in order to complete the assessment for this learning aim. Learners must be clear that they not only have to set up the system, but they have to test it, obtain feedback, optimise it and evaluate it.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they act as users of the system. Learners could draw on this information when they attempt the assignment.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 5: Building Computer Systems*
- *Unit 6: IT Systems Security*
- *Unit 9: The Impact of Computing*
- *Unit 19: Computer Networking*
- *Unit 21: Virtualisation*
- *Unit 29: Network Operating Systems*
- *Unit 30: Communication Technologies.*

City & Guilds Level 1–4 Certificate/Diploma in ICT Professional Competence (4520)

CompTIA A+ certification

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in IT. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Bruton N – *How to Manage the IT Helpdesk: A Guide for User Support and Call Centre Managers*, *Second Edition* (Routledge, 2002)
  ISBN 9780750649018
  This is a useful book, which focuses on practical aspects of user support.

Websites

- www.virtualbox.org
  This website provides free virtualisation software for creating software-based servers and client computers.
- http://blog.capterra.com/the-7-best-free-help-desk-software-tools
  This provides details of free helpdesk software.
- www.microsoft.com/en-us/server-cloud
  This is the section of the Microsoft website that deals with Windows Server software.
- www.smallbusinesscomputing.com
  This website has lots of computing-related news and articles aimed at small-/medium-sized businesses. It is updated regularly.

Unit 21: Virtualisation

Delivery guidance

Approaching the unit

The purpose of this unit is to allow learners to explore the concepts of virtualisation, as well as its application and implications in a vocational context. Learners should apply analytical thinking to consider the impact that different virtualised solutions have in a range of contexts and be able to implement a virtualised solution to meet a set of identified requirements.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, it would be appropriate to start by exploring the different types of virtualisation in order to give learners a sound understanding of the general concepts.

Next, you could consider some of the uses and applications of the different types of virtualisation. Learners should explore the computing requirements of a range of different businesses and organisations to gain a sound understanding of the types of computing processes required in vocational settings. Learners should explore how virtualisation can be utilised to meet the needs of organisations. You should expose learners to a range of business and virtualisation examples before starting the assignment in order to give them a large knowledge base to draw on so that they can make and justify decisions effectively.

When delivering the content, try to engage the help of local businesses or organisations. Using a combination of visits, to see systems in context, and guest speakers will give learners insight into how computing and, in particular, virtualisation is used to meet business needs.

For learning aim B, learners are required to demonstrate a number of practical project planning and management skills. In preparation for the assignment, ensure that learners are confident about producing planning documentation that is clear and detailed. Learners should also be able to communicate effectively with others to seek and record feedback in order to refine their ideas.

Before starting the assignment, learners will need to have a good understanding of how to use virtualisation software and should have practised setting up and modifying virtual machines.

For learning aim C, learners should be able to demonstrate appropriate testing, maintenance and review methodologies. Ensure that learners have a good understanding of selecting and applying different testing methods, creating and completing test documentation and working with others to review and refine solutions.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Examine the concepts, uses and implications of virtualisation	**A1** Types of virtualisation **A2** Computing requirements of an organisation **A3** Impact of virtualisation	A report detailing an investigation carried out on how virtualised solutions could be implemented within an identified organisation in order to fulfil the organisation's business and computing requirements.
B Implement a virtualised solution to meet identified requirements	**B1** Planning virtualised solutions **B2** Reviewing and refining plans **B3** Developing virtualised solutions	A project brief detailing client requirements, design specifications for the proposed solution, development and testing logs, meeting notes and a report that evaluates the effectiveness and appropriateness of the implemented solution.
C Demonstrate appropriate testing and maintenance procedures	**C1** Testing and maintaining virtualised solutions **C2** Reviewing and refining virtualised solutions **C3** Lessons learned from developing virtualised solutions **C4** Presentation skills **C5** Reviewing own skills, knowledge and behaviours	

Assessment guidance

This is an internally assessed unit. The recommended assessment approach is for two assignments. The first assignment should assess understanding of learning aim A and the second assignment should cover learning aims B and C.

The assignment for learning aim A could take the form of a case study based on a real organisation (or one created for the purpose of the assignment). The case study should give enough scope to allow learners to consider the characteristics of a range of different virtualisation solutions, how these could be implemented to meet identified needs and the impact they would have on the organisation.

The assignment should be delivered as a written/recorded report. This report should be professionally presented, show clear organisation and demonstrate good use of written communication. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The assignment for learning aims B and C should take the form of a practical project. Learners should develop and maintain a virtualised solution to meet the needs of a client. The scenario for the assignment should provide enough scope to allow the learners to be able to consider different solutions and demonstrate a range of testing and maintenance methodologies. It is important that the context is realistic. Learners should have a ‘client’ for whom they are developing the system and whom they will work with throughout the project. The scenario should give learners the opportunity to implement a virtual solution that could be created using desktop virtualisation software (although they are not limited to this and may wish to produce a more complex solution). The scope of the assignment should allow learners to show an understanding of using virtualisation software to emulate specific, identified hardware and software requirements to meet a range of identified client needs.

The evidence for this practical assignment should include a project brief, technical specifications, development and testing logs, quality assurance documentation, meeting notes and a report. The written evaluation should consider how effective the solution was in meeting the identified requirements. It should also make use of the outcomes of testing and reviewing to identify how the solution, and each learner’s own performance, could be improved.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 21: Virtualisation
Introduction Virtualisation gives organisations and individuals opportunities to use their available resources in effective and flexible ways. This unit gives learners an overview of the types of virtualisation available, how virtualisation can be utilised by organisations and the impact it can have. The unit also gives learners the scope to explore and develop project planning, management and analytical skills through practical application of virtualisation software.
Learning aim A – Examine the concepts, uses and implications of virtualisation
You could start learning aim A by introducing the overall aim of the unit. Give learners the 'big picture', that is, the overall aim of the unit. Explain that they will be required to produce two assignments: one that concentrates on learning aim A and one that focuses on learning aims B and C. Ensure that learners have a range of skills and knowledge before issuing the assessment. Do not use the assessment to teach the content. ● Then introduce the different types of virtualisation to learners. Your input should give learners a broad coverage of topic A1, which should focus on the characteristics of each of the listed topic points. Learners should conduct individual research to identify applications, requirements and implications of the different types of virtualisation. Why is virtualisation useful? What does it contribute to a business? ● For topic A2, give learners opportunities to explore the computing requirements of different businesses and organisations. Look at a wide range of examples, such as something in healthcare, education, business or manufacturing – there is the potential for a range of learning activities, including individual and group research tasks, guest speakers and visits to businesses and organisations. ● Learners should explore how virtualisation is used in a range of contexts to meet the requirements of businesses and organisations. Learners should consider the implications for individual users as well as for the organisation. As with topic A2, topic A3 presents opportunities for a range of learning activities, including individual and group tasks, and engagement with local employers. ● Learners should, where possible, explore real-life vocational contexts. Engagement with local employers provides a perfect vehicle for this. Where guest speakers and/or visits are not possible, try to use high-quality, factual case studies. ● Work with learners to develop their analytical skills. Explore different vocational contexts and give learners opportunities to consider the requirements of each scenario, how virtualisation could be implemented and the impact this would have.
Learning aim B – Implement a virtualised solution to meet identified requirements
Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● For topic B1, explain to learners how to use a range of planning documents to

identify user requirements and plan the scope of a system. Documentation for this unit is likely to take the form of project proposals, time plans and technical specification documents, although it may not be limited to this and may include other project planning aspects such as budgeting and testing requirements. If time allows, learners could collaborate to create documentation to support this activity. This would be a useful skill to develop as, in the real world, they may very well find it necessary to create documentation to capture computing-related information.

- To develop strong vocational skills, spend time making sure that learners can manage projects effectively, including organising meetings with the client, recording outcomes from meetings and other forms of feedback, and adjusting plans and timescales for the project, as appropriate.
- Work with learners to ensure that they have effective and appropriate communication skills. Learners should appreciate the opportunities and limitations of different communication tools (such as the 24/7 availability of email compared with its perceived disadvantages, or the benefits of face-to-face contact with clients in helping to develop a sound stakeholder relationship compared with the time limitations). All project documents and communication with clients should use the appropriate style, tone and content.
- Before starting work on the second assignment, you will need to provide practical introductions to the use of your chosen virtualisation software/platform. Learners will need to know how to set up and modify virtual machines, adjust hardware emulation settings, and install, update and maintain software (including operating systems, utility and productivity applications), as required.
- Also, give learners opportunities to explore the use and preparation of the host computer/hardware, such as installing virtualisation software, creating space on a hard drive or setting up/adjusting partitions.
- Make learners aware of how to document their development process. For example, you may need to show learners how to effectively use screen-capture tools to produce screenshots and screen recordings, as required.

Learning aim C – Demonstrate appropriate testing and maintenance procedures

Understanding of learning aim C should flow naturally from learning aim B and learners will need to be able to apply this understanding as part of a larger project. As with learning aim B, learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Give learners opportunities to explore a range of testing methodologies to develop understanding of how and why different systems are tested in different ways. Learners should understand that the skill of the IT practitioner is the ability to judge situations and apply the right tools and techniques in given situations.
- Learners should be able to select appropriate testing methodologies so that solutions can be thoroughly tested and reviewed. They should be able to appropriately and thoroughly plan and document the testing process. Learners must understand that they will sometimes need to defend their choices and their position in relation to decisions they have made.
- To develop understanding of the testing and review process, give learners opportunities to use pre-existing virtualised solutions, which they can test and review, identifying areas for development and improving the solutions.
- Try to develop learners' evaluative skills. They should be able to use the outcomes of testing and review to evaluate the quality of solutions (and their own performance, as appropriate) against project requirements and client expectations.

- Work with learners to ensure effective and appropriate presentation skills. All project documents and 'client' communication should use the appropriate style, tone and content. Learners must remember that, in these situations, they are representatives of their employers, so it is not only their own professional reputations that they need to protect.
- The assignment should provide a valid, vocational context. For the duration of the project, learners will be expected to work with a 'client' who will set the expectations, provide the operating requirements, set and negotiate the timescales and so on.
- The 'client', where possible, should be a real-world client with whom the learner can engage. While the project might be 'simulated', in that it may not be a live project, engaging with local employers to provide a vocational setting would be invaluable. If real-world clients are not a possibility, ask another adult to simulate the role of 'client'. Other learners should not fulfil this role, although they could be test users. It is important for the 'client' to have a sound knowledge of the project and the related computing requirements.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they act as users of the system.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 2: Fundamentals of Computer Systems*
- *Unit 3: Planning and Management of Computer Projects*
- *Unit 9: The Impact of Computing*
- *Unit 19: Computer Networking*
- *Unit 20: Managing and Supporting Systems*
- *Unit 29: Network Operating Systems*
- *Unit 30: Communication Technologies.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- https://software.dell.com/whitepaper/ebook-the-definitive-guide-to-virtualization-management-software872556
  Dell – a guide to virtualisation management software.
  (**N.B.** As this field of study changes rapidly, this guide may become outdated. It is a suggested starting point.)
- www.virtualbox.org
  Oracle VirtualBox – free desktop virtualisation software.
- www.linux-kvm.org/page/Main_Page
  Kernel Virtual Machine (KVM) – open source virtualisation software.

Unit 22: Systems Analysis and Design

Delivery guidance

Approaching the unit

The purpose of this unit is for learners to investigate the principles of systems analysis and design, then develop their skills and use those principles to analyse and design a solution to meet the needs of an organisation.

In this unit, learners will use systems analysis methods to examine an organisation and analyse its current systems. They will plan for a new or revised system to be developed to suit an organisation's requirements. The learners' designs may be used to create a new IT system or develop an existing one.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could begin with an introduction to software development and discuss the purpose of systems analysis.

You could then introduce development models and their life cycles. Learners must understand the benefits of software development life cycles and be familiar with traditional and agile methodologies.

Learners should investigate the tools and techniques available to systems analysts, and how and why they are used. Learners should also be familiar with computer-aided software engineering (CASE) tools and should be able to make judgements on which methodologies suit which situations.

When delivering learning aim B, refer back to the concepts identified in learning aim A. You could start by discussing how to identify an organisation's business needs and the techniques that learners could use to gather required information from non-technical staff members.

Make sure that learners are familiar with potential threats to projects and the overall success of a system. You could spend time discussing why projects might fail. Some real-life examples, or a guest speaker, would be useful here.

As with any software design, learners should be familiar with what is being designed. You should guide learners in the process of choosing appropriate models to use in their designs. They should be familiar with techniques used in program design and be confident in applying the ones they will use in their own designs.

The goal of learning aim B is to investigate an organisation's computing needs and produce a requirements specification according to the needs identified. To this end, ensure that learners understand how to produce the necessary documentation.

For learning aim C, give learners as much practical experience as possible. Introduce the use of diagramming techniques early and allow learners time to experiment with the tools available.

In this learning aim, learners will design their systems from the requirements identified in learning aim B. Learners must be familiar with modelling the interface requirements and the design of data flows within a system. They must also be confident with the use of testing processes and recommending maintenance plans.

You should allow time for learners to review their draft designs with their peers. This should be done late enough that the learners have detailed designs, but early enough that they will have time to make refinements based on the feedback they receive.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Examine the principles of systems analysis and design</td><td>A1 Development models
A2 Systems analysis tools and techniques</td><td>A report that explores software development models and systems analysis tools and techniques and their suitability for modelling business processes.</td></tr>
<tr><td>B Investigate the computing requirements of an identified organisation</td><td>B1 Computing and business needs of an identified organisation
B2 Investigation techniques that use standard analytical methods
B3 Threats to systems success
B4 Requirements specification</td><td rowspan="2">A requirements specification document covering the business needs and overall requirements of the new system.
A completed design for the proposed system, including input and output definitions, data and process modelling and testing methodology.
A report evaluating the requirements specification and design against the organisation’s requirements.</td></tr>
<tr><td>C Develop a design for a computing system to meet an organisation’s needs</td><td>C1 Input and output requirements
C2 Data and processes within a system
C3 Testing and maintenance methodologies
C4 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This unit is internally assessed. The recommended assessment approach is for two assignments.

Assignment 1 should cover learning aim A. It should be an investigation of the principles of different software development models, and features of the tools and techniques available within those models. For higher grades, learners need to consider the suitability of development models in specific scenarios. The assignment could be delivered as a written report in any acceptable format. A blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Assignment 2 covers learning aims B and C. The assignment is project-based, where learners produce their own designs to give a solution for an organisational requirement. Learners will be expected to analyse the problem and design a justified solution. Learners should present the assignment as design schematics with a requirements specification document and associated report.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 22: Systems Analysis and Design

Introduction

Systems analysts investigate organisations to determine their needs for computing systems. They design solutions to meet an organisation's needs, and plan changes and updates to the solutions they develop. Systems analysts are key personnel in software development projects, and they have good technical knowledge and problem-solving skills.

Learning aim A – Examine the principles of systems analysis and design

It is important that learners understand the purpose of software development and why it should be structured. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Spend some time discussing software and the purpose of software development. Learners should be able to define what software is and why organisations might require bespoke software. There are many examples of bespoke systems on the internet, including examples of systems that succeeded and those that failed.
- Work with learners to develop their analytical and evaluative skills. Explore different work-based contexts and give learners opportunities to consider the requirements of each scenario. These scenarios should be across sectors and not solely focused on business situations.
- Learners then need to investigate development models. This is where you will introduce various life cycle models and how they are used. You should explain the waterfall model and any other models that you think might be helpful to learners. Include several models covering traditional and agile methodologies. Learners should understand that methodologies are good for giving investigations a structure, but can limit creativity.
- Learners should understand the stages of the software development life cycle and the methodologies you have discussed.
- With greater examination of each stage, cover the diagramming techniques and documentation tools. This would be a good time to introduce computer-aided software engineering (CASE) tools, by introducing learners to sample software (there is a wealth of free software online that learners could access and use).
- Learners should be able to discuss the suitability of methodologies based on the required development project.

Learning aim B – Investigate the computing requirements of an identified organisation

Learners should investigate the systems and requirements of a variety of organisations. Give learners sample case studies and examples of good practice within industry, wherever possible. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Learners should investigate an organisation – they should be confident in identifying an organisation's structure and purpose, the organisation's goals, the services it provides and the needs of its customers and its staff. This could present an opportunity for working with an employer, particularly, if the learners go on to develop the solution at a later stage.

- Learners should be familiar with analytical methods and be able to comment on their accuracy. Learners should be able to decide which methods work best in different situations, and they should be able to justify their choices.
- It is important that learners can accurately document their analysis accordingly and can follow necessary protocols when conducting analysis (for example, relating to confidentiality, company policy and security).
- Work with learners to ensure that they have effective and appropriate communication skills. All project documents and communication with clients should use the appropriate style, tone and content. Learners may also benefit from understanding how negotiation may benefit an analysis scenario.
- Learners must understand why projects fail. They must be able to identify risks to a development project and what effect they could have on the success of the project. It would be useful to provide case studies showing failed projects as well as successful ones to allow learners to investigate what went wrong. If possible, invite a guest speaker to talk to the learners, to emphasise the success and failure of real-life projects.
- Following their analysis, learners should draft a requirements specification for a proposed new system. It is imperative that learners understand the documentation required and are able to produce it. Again, if possible, it would be useful for learners to have access to case studies or real-life examples (which could be provided by a guest speaker or visits to a local business/organisation).

Learning aim C – Develop a design for a computing system to meet an organisation's needs

Learners will design a new computing system for an organisation to meet its needs or improve on its existing computing system. Give learners sample case studies and examples of good practice within industry, wherever possible.

- Learners should be able to identify the parts of the system that they will be modelling and know which techniques they should use for each part. A wide range of techniques should be studied and learners should demonstrate an understanding of which technique to use in which situation.
- Learners should be confident in designing user interfaces with different purposes and requiring different options for multi-platform deployment. It could be useful to demonstrate differences between desktop and mobile screen options.
- Learners must be able to discuss the software and hardware requirements for running their proposed system and be able to accurately record their proposals, for discussion with the client.
- Learners must be capable of modelling the data, storage and processing within their system using appropriate methods. Learners must be able to select diagramming techniques and use them accordingly.
- Testing is required in all software projects and learners must design adequate testing processes to ensure that they end up with a robust product. Learners should be familiar with testing methods and creating maintenance proposals.
- Learners should have time to review their draft designs with their peers. If a real client has been used, he or she could be invited to be involved in the review and to contribute to the process. This allows learners to make informed decisions, based on feedback, to make improvements to their designs. A good way to do this would

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be to hold presentation seminars where learners discuss the merits of specific designs and identify any areas that need improvement.

- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they act as test users of the system. If possible, learners should also have sought testers outside their peer group (family members or friends would be ideal, particularly if different user types could be accessed).
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3: Planning and Management of Computing Projects*
- *Unit 10: Human–Computer Interaction*
- *Unit 14: Computer Games Development*
- *Unit 15: Website Development*
- *Unit 16: Object-oriented Programming*
- *Unit 17: Mobile Apps Development*
- *Unit 18: Relational Database Development*
- *Unit 23: Systems Methodology*
- *Unit 24: Software Development*
- *Unit 25: Web Application Development*
- *Unit 32: Business Process Modelling Tools.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Pressman R and Maxim B – *Software Engineering: A Practitioner's Approach*, *Eighth Edition* (McGraw Hill, 2014) ISBN 9780078022128
  This is a comprehensive guide to software development. Digital and online copies are available.

Websites

- www.tutorialspoint.com/software_engineering
  Tutorials point: tutorials available for software engineering.

- www.w3computing.com/systemsanalysis
  Comprehensive W3 computing tutorial for systems analysis.

Unit 23: Systems Methodology

Delivery guidance

Approaching the unit

This unit helps learners to investigate the systems methodology and techniques used by software engineers to solve complex problems. In any software development project, developers use a systems methodology. As such, try to incorporate real-life examples, guest speakers and practical demonstrations and activities as much as possible.

Learners should start by researching the principles of systems methodology, along with the tools and techniques used to solve computing problems. Learners should select and apply systems methodologies to solve a formulated problem and then review their solution, taking account of feedback.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

In learning aim A, introduce the software development life cycle (SDLC) early on. It is important that learners understand each stage of the SDLC and why it is useful.

Learners should investigate traditional methodologies such as the structured systems analysis and design method (SSADM) in addition to agile methodologies such as the dynamic systems development method (DSDM). Also, explore with learners the tools and techniques available within those methodologies and the use of computer-aided software engineering (CASE) tools.

When delivering learning aim B, refer back to the concepts identified in learning aim A. Build on that knowledge by applying these concepts, with reference to case-study materials and examples.

Learners should be able to investigate a problem within a computing environment. They need to produce a problem statement and a project proposal to fix the problem. Learners must be able to select appropriate systems methodology techniques and tools, and apply them in the modelling of the solution to the problem. Try to give learners the opportunity to review examples of this or to hear from guest speakers in order to give them greater insight into the process.

In learning aim C, learners should review their solutions to the computing problem identified in learning aim B. They must be familiar with the sources of information available to them (such as the problem statement and feedback from others) and different review and evaluation criteria (e.g. testing processes and time management). Learners must also understand how to use the information available to make recommendations for the improvement of their solution. Give learners the opportunity to review examples or to compare each other’s solutions in order to identify issues that need to be resolved or rectified.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Investigate the principles of systems methodology and systems techniques used to solve computing problems	**A1** The software development life cycle **A2** Systems methodology principles **A3** Systems methodology techniques	A report focusing on the differences between various systems methodologies and techniques that could be used to solve computing problems, depending on the nature of the computing problem.
B Apply systems methodology tools and techniques to identify and solve a computing problem	**B1** Problem investigation **B2** Selecting appropriate systems methodology **B3** Applying systems methodology techniques **B4** Applying systems methodology tools	A practical activity using systems methodology techniques and tools to solve the problem statement. The evidence will include a report outlining the problem statement and a possible solution, drawings and planning documentation.
C Review a solution to a computing problem	**C1** Reviewing the development process and outcomes **C2** Skills, knowledge and behaviours	An evaluation of the use of systems methodology to solve a computing problem and a conclusion of improvements that could be made to the solution. The report will show accurate understanding of the fundamental processes of systems methodology.

Assessment guidance

This unit is internally assessed. The recommended assessment approach is for two assignments.

Assignment 1 should cover learning aim A. It should consist of a report investigating the differences between various systems methodologies and techniques that can be applied during a software development project to solve a computing problem. Learners should provide explanations of the purpose of each stage of the software development life cycle and apply the principles of systems methodologies to a case study scenario. The report could be written, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

Assignment 2 should cover learning aims B and C and should be practical and project based. Learners should investigate a computing problem, define a problem statement and propose a solution to the problem. Learners will need to provide documentation for the methodologies, tools and techniques applied to solve the problem. They should also evaluate the use and effectiveness of the systems methodology that they chose for solving the problem and make suggestions for possible improvements.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 23: Systems Methodology
Introduction A systems methodology is the framework used in software development projects – a method for the life cycle of a project. To build robust systems, design teams use methodologies to ensure that the project runs smoothly through all stages of development.
Learning aim A – Investigate the principles of systems methodology and systems techniques used to solve computing problems
Learners must understand the importance of using structured models in software development projects. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● Spend some time discussing the overall purpose of systems methodologies. It may be useful to show examples of software designed using a structured methodology and compare these with examples of software produced without it. ● Learners must investigate the software development life cycle (SDLC). It is important that they have a good knowledge of each stage of the SDLC as this will form the basis of a pass criterion. Learners should know the steps in order and should be able to produce an annotated diagram. ● Introduce methodologies to the learners, tying them in with the SDLC and the design of software, as appropriate. Learners should investigate traditional and agile methodologies, and understand how to select the appropriate method depending on the circumstances. Learners would also benefit from investigating recent or emerging developments such as the agile methodology Scrum. ● Give learners examples of, and opportunities to practise, different techniques for modelling systems and designs. Learners should be confident about using structured and object-oriented techniques. They should also have opportunities to use CASE tools. ● Work with learners to develop their analytical and evaluative skills. Explore different work-based contexts and give learners opportunities to consider the requirements of each scenario.
Learning aim B – Apply systems methodology tools and techniques to identify and solve a computing problem
Learners should investigate computing problems and their solutions. In order to design a solution to a computing problem, it would be beneficial for learners to use CASE tools, so make sure that learners are familiar with their use. Wherever possible, give learners sample case studies and examples of good practice. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● When investigating a problem, learners should be confident about defining a problem statement and a project proposal to suggest solutions to the problem. ● Learners should build on their knowledge of several methodologies from learning aim A. They should feel confident about selecting an appropriate methodology for use on a specific project and about justifying the chosen methodology. This is

important so that they can document their application of methodologies accordingly.

- You should explain the use of diagramming and modelling of a solution, giving learners various examples. Learners should have time to practise constructing their own diagrams and models to improve their skills. Learners should also understand what the inclusion of diagrams contributes to an overall design.
- As mentioned above, learners should be able to use CASE tools for modelling solutions to a problem. They should also be able to project manage their solutions.

Learning aim C – Review a solution to a computing problem

The objective of learning aim C is for learners to review their project to evaluate what they have achieved and how well they achieved it. Learners should be able to critically examine their solutions and make suggestions about how to improve them, in terms of process and practicalities.

- Learners must be able to identify and utilise sources of information that will add to the review of their computing solutions.
- You should highlight areas that should be reviewed and to what criteria. Learners will need to review their own work as part of their assessment, so it would be beneficial for them to read some examples of reviews. If possible, these should be examples of real-life projects.
- In preparation for assignment 2, learners should have time to peer review presentations (on a topic of each learner’s choice) so there is a practical opportunity to understand how to make informed decisions about improving a piece of work, based on feedback. A good way to do this would be to hold presentation seminars, where learners can discuss the merits of each presentation and identify any specific areas for improvement. Learners should be taught how to present a supportive critique of other's work.
- Learners should be confident about critically examining their own work to inform decisions on possible improvements and be able to provide an assessment of their own performance throughout the project.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 16: Object-oriented Programming*
- *Unit 22: Systems Analysis and Design*
- *Unit 24: Software Development*
- *Unit 32: Business Process Modelling Tools.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Pressman R and Maxim B – *Software Engineering: A Practitioner's Approach, Eighth Edition* (McGraw-Hill, 2014) ISBN 9780078022128
  This is a comprehensive guide to software development. Digital and online copies are available.

Websites

- www.tutorialspoint.com/software_engineering
  This site provides tutorials on software engineering from Tutorials Point.
- www.itinfo.am/eng/software-development-methodologies
  This site provides information about software development methodologies from IT Knowledge Portal.

Unit 24: Software Development

Delivery guidance

Approaching the unit

In this unit, learners will examine the principles of computer programming, and they will design and develop their own software solutions to meet an identified need. You will also have some flexibility regarding which particular programming language to use in this unit. You may want to use either a C family language or Python. Learners may be registered with Code Academy, which utilises Python. This provides excellent exercises that give learners opportunities to embed programming constructs and techniques to build computer programs.

Allow learners to have access to a small range of languages. This is useful so that they can compare and contrast the different techniques and constructs that the programming languages employ. However, it is recommended that learners utilise only one language when developing their programming skills.

Programming skills and the associated analytical and problem-solving skills are vital in the computing industry. It is important that the activities that you set for learners are inspiring, motivating and based on real-world scenarios, as this will help them to understand the potential of programming.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

You could start learning aim A by introducing the topic of software development and explaining how learners will be assessed in this unit. Then have a brainstorming session in which learners should come up with as many potential uses of software applications as possible and state why they think that these uses are advantageous. Consider, for example, how computer gaming has revolutionised online communication and the wide ranging effects of social media.

Using some of the suggested examples where possible, discuss the advantages and disadvantages of different programming languages and how the requirements of the finished product can dictate the choice of language. Learners could then go on to research how different programming constructs and techniques are used in different languages – in particular, the differences between different IDEs – while developing skills in their chosen language. The choice of programming language is left to the centre, but common choices are usually C++, C, Python or Java. There will be an opportunity for learners to study a range of languages across the course (depending on the centre's choice of units).

You should give careful consideration as to which programming language learners should use. For example, learners could be provided with several options, ranging from gaming engines such as Unreal and Unity to code in C++ or C#. Alternatively, Code Academy utilises innovative, interactive sessions using Python. It is advisable, when learners are upskilling their knowledge of programming, to commit to one language so as to not overwhelm them.

Although learners should be allowed to research and investigate different programming languages, you should make it clear that they will use only one language to create their own software solutions. As already mentioned, when you plan the unit, consider which programming language will be most suitable for the assignment.

For learning aim B, explain how the software development life cycle is applied in a practical context and where the design element of software development fits within the life cycle. This learning aim lends itself to practical activities for learners to work through, so you should follow every 'theory' session with practical activities. Give learners plenty of time for peer support and peer evaluations to help them to refine their design solutions and develop their skills.

In learning aim C, learners will use their programming skills to develop coding solutions to problems. Explain the process of software development and ask learners to suggest reasons why testing is so important. When carrying out practical tasks, give learners opportunities to work both individually and collaboratively. For example, a 'super peer', that is, someone who has an excellent grasp of the subject content, could be assigned to the group. However, if learners work together, you must track their progress to ensure that they all understand the concepts being delivered. If you identify a topic that several learners are struggling with, you could support them by bringing the class together to discuss and work through the topic collaboratively. This will allow all learners to make progress and develop their programming skills.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Examine the principles of computer programming</td><td>A1 Uses of software applications
A2 Features and characteristics of programming languages
A3 Constructs and techniques and their implementation in different languages
A4 Principles of logic applied to program design
A5 Quality of computer programs</td><td>A report evaluating how the principles of software design and computer programming are applied to create effective, high-quality applications.</td></tr>
<tr><td>B Design a software solution to meet identified requirements</td><td>B1 Software development life cycle
B2 Software solutions design</td><td rowspan="2">A project brief identifying the scope of the problem and user/client requirements.
Design documentation for the suggested solution.
User feedback and design refinement documentation.
Development and support documentation, including development and testing logs, meeting notes and a report that evaluates the outcomes and development of the project.</td></tr>
<tr><td>C Develop a software solution to meet identified requirements</td><td>C1 Software solutions development
C2 Testing software solutions
C3 Improvement, refinement and optimisation of software applications
C4 Review of software solutions
C5 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This unit is internally assessed by means of two assignments. The recommended approach is to set one assignment covering all of the learning aim A assessment criteria, and the other covering all of the criteria from learning aims B and C. Therefore, in the second assignment, learners will need to design and develop software solutions to meet specified requirements.

Revision sessions and mock assessments should be organised so that learners can practise their skills in preparation for their actual assessment. It is important that learners are fully prepared for this before starting the assignment. Do not use the assessment as a means of teaching the content of the learning aims. Support and guidance can be provided within their mock assessment, but it is important that, when learners complete their actual assignment, it is their own work and that this can be authenticated. They must sign the assessment cover sheet to affirm this.

Think creatively when setting assignments. The report for learning aim A could be in the form of a written document, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language. When learners are evaluating their design decisions, you could use a *Dragons Den* style means of presentation. Learners could use Prezi, which is an innovative presentation tool. Feedback from these sessions could be recorded on observation sheets to provide evidence in support of refinement to learners' work.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 24: Software Development
Introduction This unit may be the first time that learners encounter programming. Explain what programming is, and how the knowledge and skills that they will gain in this unit will be useful in further study or employment.
Learning aim A – Examine the principles of computer programming
● Establish learners' prior knowledge by brainstorming all the elements of software development that they know about, including any programming languages that they can name. This could be done in pairs or small groups, with each pair or group feeding back their thoughts to the whole group in a tutor-led discussion. ● Explain the uses of software applications, using real-life examples such as bomb disposal robots or warehouse logistics. You should cover: o gaming and entertainment o productivity o information storage and management o repetitive tasks or dangerous tasks o social media o search engines. Divide the group into pairs or small groups and allocate one of these uses to each pair or group. Learners could work together to create posters, podcasts or short films about the uses, advantages and disadvantages of a particular category of software applications. ● Work with learners to develop their analytical and evaluative skills. Explore a variety of different contexts and give learners opportunities to consider the requirements of each one. Learners could evaluate different programming languages, and their suitability for creating modern-day computer programs in different contexts, justifying their choices (e.g. this program is for young people so we have chosen...) ● Carefully select a programming language for learners to use. If you choose to use Python, learners can be registered with Code Academy, which provides exercises to help them explore the content in the unit specification. Learners should cover all the elements of a programming language, such as the constructs and techniques, and understand how principles of login should be applied to a program. If it is deemed that Code Academy is not the most appropriate solution for upskilling learners, other methods should be considered. For example, you could enable learners to watch video-based tutorials or supply them with workbooks containing exercises that progress in level of difficulty. If the language is chosen carefully, sites such as CodingGround may provide opportunities for learners to code at home. ● If your learners are in the Creative Computing pathway, you may consider using gaming engines such as Unity or Unreal where learners can use C++ or C# to develop code which can be used to create basic 2D or 3D games. You could vary

the delivery of these units, so that learners sometimes work individually and sometimes in pairs or small groups.

- As an individual research activity, you could allocate two programming languages to each learner and ask them to research their given languages. They should then investigate, with a focus on comparing and contrasting, their given languages. After this, they should consider a given problem and decide which language would be best to use to create a software solution for the problem.
- Learners will need to investigate fully how the design and implementation of a computer program affects its quality. You could decide to allocate learners into small teams and give each group a key term to research and investigate. They could collate their findings in a podcast, a Prezi presentation or a pre-recorded video. Learners in the audience could then ask questions to check their understanding. This would also provide the tutor with an opportunity to use the recordings as part of each learner's pastoral activity (for discussions on skills building and areas for improvement).
- Investigate any local software development companies to see if any of their staff would be willing to visit your centre as a guest speaker. This would give learners the opportunity to hear from someone who works in the computing industry. They could also ask questions, for example about the skills needed to work in the industry. Do not forget that your centre has an alumni of learners who may well have gone through one of the previous BTEC Software Development programmes. These previous students will probably be working as commercial programmers and will provide lots of opportunities for employer engagement.

Learning aim B – Design a software solution to meet identified requirements

- Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.
- Explain the software development life cycle to learners, working through each stage in turn. Focus particularly on the design stage and brainstorm learners about the sort of things that they think should be considered at this stage. Learners should understand that each stage of the life cycle is equally important and that failure to meet the objectives of one of the stages can result in failure of the development. The area that is most frequently overlooked is testing. In the case of computer games, testing is seen as one of the fun parts of development. This is less so when the program is simply data processing or file handling.
- Hand out a variety of design documentation types, such as client briefs, for learners to look at and review. Ask learners to consider what improvements could be made and to identify if anything is missing. Alternatively, ask if there is any information in the design documents that they think is irrelevant. Learners will need to justify how the design decisions that have been made result in an effective solution to a specified problem. This is a key skill for programmers who often have to defend the creative decisions they make.
- Learners will need to develop high-level analytical and evaluative skills to evaluate designs against the needs of the client. To gain practice at this, they could evaluate the programs that they have developed or evaluate different operating systems. For example, learners could be asked to evaluate how Windows 10 compares with Windows 8.
- Lead a group discussion on the importance of testing and the reasons why software needs to be tested. You could ask learners to contribute any experiences of using software applications or web applications that do not appear to have been adequately tested. There are many examples of systems that have failed owing to

poor testing, such as Heathrow Airport's Terminal 5 luggage-handling system that encountered problems when it was launched in 2008. You could also ask learners to investigate the failure of the London Underground's Central Line signalling system which was not tested in real time and was found to be unable to cope when activated.

- In pairs or small groups, learners could work together to create design documentation for a solution in a given scenario. You could give every pair or group the same scenario to work from. This would allow them to see a variety of possible solutions.
- Explain how important it is that software solutions are based on robust designs, using real-life examples, where possible. Learners need to understand that, if they develop coding solutions based upon incorrect designs, the software solution will also be wrong.
- Give learners a mock assignment to test their knowledge and skills. The scenario that you provide should give scope for learners to design a software solution to meet the identified requirements. The same scenario can then be used in the mock assignment for learning aim C, for which learners will need to develop the software solution that they have designed.
- Learners should have the opportunity to gather feedback on their mock assessment designs. You could do this in one-to-one tutorials. You could also ask learners to present their design documentation to the rest of the class and answer questions on their work.

Learning aim C – Develop a software solution to meet identified requirements

- Start by leading a discussion about what learners have understood from the previous learning aim. Focus on the software development life cycle in order to lead in to the development process.
- Give learners a variety of programming tasks, so that they can see the varied applications of software development. Start with something relatively simple, such as developing a calculator application. The calculator should accept numbers and calculate using +, -, / and *. Walk through learners' finished applications, answering questions and correcting basic misconceptions.
- Use practical development tasks, as in the previous activity, to introduce learners to the testing process. Demonstrate how to test using typical, extreme and erroneous data, and then ask learners to do the same with the application that they created in the previous task. Learners should understand that designing test data is as important as coding the solution in the first place. Once learners have completed the test process, walk through model answers and check learners' understanding with direct questioning. Group learners into pairs so they can critique each other's software solutions from the mock assessment that they completed as part of learning aim B. Learners must know how to gather feedback from users in order to improve and optimise their solutions, so talk them through designing surveys or questionnaires. Explain to learners how they should use this feedback effectively (and supportively) in order to improve their designed solutions, both before and during coding.
- You could bring in guest speakers from local computing businesses to give feedback on learners' designs. If this is possible, you could use the opportunity to arrange a *Dragon's Den*-style pitching session, in which learners have to pitch their design ideas to the panel and receive feedback.
- Learners should work independently on developing their designed solutions, so that this can act as a mock assessment in preparation for the live assignment.

- Once learners have gathered their feedback, they should optimise their solutions in line with the suggestions and observations that they have been given. Learners must keep track of the changes that they have made, perhaps by keeping a video diary or blog of the development process. This will be very useful for helping to justify decisions made when carrying out the final evaluation and review.
- Learners could give a 'before and after' presentation to the rest of the group, demonstrating how their finished software solutions have been improved by the amendments made after receiving feedback.
- Learners should work independently on the mock assessment and review their own final software solutions. Make sure that they have plenty of time to review and evaluate their developed product and their own skills, knowledge and behaviours. You could run a workshop devoted to topic C5, introducing learners to action plans, SWOT analysis and SMART targets, as this will help them to prepare for the real assessment.
- Learners should demonstrate individual responsibility and self-management through the process of their assessment. This could be done by allowing them to set their own SMART targets within a session, so giving them control over their own learning. Tutors can track their progress and stretch and challenge learners by giving them shorter times to complete their targets.
- Throughout the entire design, development and review process, learners must demonstrate some levels of creativity. They should be encouraged to include 'outside the box' thinking by developing innovate designs to solutions. Learners should understand that, in programming, there is no 'right' method for every scenario – but there could be a more 'efficient' one. In addition, their programs could incorporate extra elements that are not necessarily required for the unit specification. For example, learners who are also studying *Unit 16: Object-oriented Programming* could incorporate elements of object orientation to elevate their software solution.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

978-1-44692-831-8 – Pearson BTEC Nationals in Computing – Delivery Guide

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3: Planning and Management of Computer Projects*
- *Unit 4: Software Design and Development Project.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Davis S – *C++ for Dummies, 7th Edition* (John Wiley & Sons, 2014)
  ISBN 9781118823774
  This is a useful guide for introducing C++. It delivers the main concepts addressed in the unit specification.
- Green J – *Head first C#, 3rd Edition* (O'Reilly Media, 2013)
  ISBN 9781449-43507
  This is a useful book for those who are new to C# programming.
- McGrath M – *Python in easy steps* (In Easy Steps Limited, 2013)
  ISBN 9781840785968
  This is a book for people who are starting to code in Python.

Websites

- www.cplusplus.com/doc/tutorial
  This site gives clear explanations of the basics of C++, such as program structure and compound data types, as well as other useful features.
- www.python.org
  Python can be downloaded here free of charge.
- www.youtube.com/watch?v=tvC1WCdV1XU&list=PLAE85DE8440AA6B83
  C++ Programming Tutorials – video tutorials on how to use C++. These are suitable for inexperienced users.
- www.youtube.com/watch?v=4Mf0h3HphEA&list=PLEA1FEF17E1E5C0DA
  Python Programming Tutorials – video tutorials on using Python. These are suitable for inexperienced users.

Unit 25: Web Applications Development

Delivery guidance

Approaching the unit

This unit gives learners the opportunity to investigate web applications and server-side scripting. As part of their assessment, learners will design and develop a web application. This will equip them with the skills and knowledge necessary for website development. Websites are essential to most companies today and the ability to develop a website is a skill that is sought after by many employers.

You will need to make sure that learners have access to adequate software resources, such as those stated in the unit specification, in order to complete their set tasks. Preferably, learners will have access to a selection of development environments, servers, text editors and so on, as this will give them more opportunities to compare the available development options. It would also benefit learners to hear from computing professionals, perhaps as guest speakers or at technical workshops, so that they get a real-world perspective on the issues that they will encounter in this unit.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

You could begin learning aim A by discussing websites, web applications and the differences between client-side and server-side scripting. Ask learners to name and discuss some of the web applications that they are familiar with (e.g. Facebook and Amazon). You could use these as examples to show how the applications and principles covered in this unit are used in the 'real' world.

Learners should investigate several server-side web applications and be able to examine the use of server-side scripting within them. It may not be possible to examine the workings of websites that the learners use on a daily basis, so you should have several workable examples (e.g. dynamic web pages, a login system or a shopping cart) to demonstrate this.

Use case studies to introduce the ways in which security principles are applied. Learners will need a good understanding of the threats to web applications and must be able to formulate ideas about how to counteract these threats, so contextualising the principles will be beneficial.

Make sure that you set aside time early on in the unit to introduce your learners to the programming and development environments that they can use for their project. They will need to understand the available options and will need time to practise their skills.

Learning aim B focuses on the skills and techniques required to design a web application. Show them examples of design documentation so that they become familiar with their layout and content. You should also guide learners through the process of choosing appropriate scripting techniques to use in their designs, and it would be beneficial to set a mock assignment for learning aim B. Learners should be familiar with techniques used in web application design and be confident in the use of those techniques in their own designs.

Following on from learning aim B, learning aim C focuses on the development of learners' web applications. Give learners the opportunity to gain as much practical experience as possible. You could do this by running workshops on the use of the chosen environment and tools, to ensure that they can make use of the tools and techniques listed in the specification. You could also set aside supervised independent study time in the ICT suite for learners to experiment with the available tools and to ask for guidance.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Understand the applications and principles of web server scripting</td><td>A1 Types of web server scripting languages
A2 Applications and principles of web server scripting
A3 Security in web server scripting</td><td>A report providing an introduction to scripting principles, languages and uses, including security considerations.</td></tr>
<tr><td>B Design a web application to meet client requirements</td><td>B1 Web application design
B2 Web hosting, features and tools</td><td rowspan="2">Design documentation showing the planning, preparation and design for a web application to meet a client’s requirements.
Presentation of a functional web application with supporting development and testing documentation.
A report evaluating the web application against the design.</td></tr>
<tr><td>C Develop a web application to meet client requirements</td><td>C1 Common tools and techniques used in web server scripting
C2 Common tools and techniques used in database integration
C3 Testing a web application
C4 Reviewing and evaluating a web application
C5 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This unit is assessed by means of two assignments. One assignment should cover learning aim A, while the other assesses learning aims B and C.

The first assignment is an investigation of web applications. Learners will need to examine the scripting used in existing web applications and discuss the security threats and measures within web applications. This could be in the form of a written report, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The second assignment is project based. Learners will need to design and develop their own web applications to meet a client's requirements. As part of this, they must consider hosting options, database integration and the features to be included in their websites. They should each present a functional web application with associated design and development documentation.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 25: Web Application Development
Introduction The worldwide web was developed in the 1990s and has rapidly grown to what it is today. Websites are an essential part of the computing world and, in this unit, learners will investigate web applications and server scripting (a vital part of the web and one that allows secure and interactive use). Explain to learners that they will design a website and implement server-side capabilities using web server-scripting languages to provide secure interactive functionality.
Learning aim A – Understand the applications and principles of web server scripting
• Learners will need to know about several website implementations, so give them plenty of examples of web applications with different functionality and implementations. Examples could include (but not be restricted to) shopping basket systems and product details in sites such as Amazon. • Discuss some case studies of web application development, using real examples, where possible. Learners should be encouraged to select a site that they use regularly and asked to consider it in relation to another site with similar content and functionality. As learners come to a better understanding of the process, start to ask them to identify good practice and poor practice in the given examples. This should not be limited to personal preference, but they should consider the sites from a technical perspective. • Work with learners to develop their analytical and evaluative skills. Explore a variety of different contexts and give learners opportunities to consider the requirements of each one. • Give demonstrations of web server scripting. It would also be beneficial for learners to have access to a server and demonstrations of the functions you discuss. • Learners should be familiar with types of threats to web applications, the potential issues they could cause, and the severity of a breach in security. To ensure this, you could lead discussions of threats posed to the websites already investigated and how they could affect the website or the user. Learners should consider encryption methods and how these are used to make the user experience more secure. During these discussions, it would be useful to highlight areas of vulnerability and include examples of how they can be countered to ensure secure web applications. Learners should be taught how to find up-to-date information about current threats and vulnerabilities so that they can themselves stay up to date. • Introduce learners to programming and programming environments for website development and allow plenty of time for them to work with development tools on a regular basis. This will be especially important if they have not already done any programming in other units. A good way of achieving this would be to provide learners with workbooks containing exercises of an increasing level of difficulty, which they could complete in their own time and at their own pace.
Learning aim B – Design a web application to meet client requirements
Learners should be equipped with a range of skills and knowledge before starting the

assignment – do not use the assignment as a vehicle to teach the content.

- Guide learners through the process of choosing appropriate methods to use in their designs. You could do this by demonstrating how you would choose an appropriate method for the design of an example web application. Alternatively, this could be a good point at which to invite a guest speaker from a web development agency to discuss the process of design from a professional perspective.
- Learners should understand the importance of documenting design decisions, so that they can provide evidence of their consideration of the audience and any constraints and to ensure that these can be justified to the client, if necessary. Learners should be familiar with techniques used in website design and be confident in the application of the techniques that they will use in their own designs, so give them time to practise their skills. You could do this by arranging time for supervised independent study in the ICT suite.
- In pairs or small groups, learners could discuss the types of web applications that they would be interested in designing. They could use the examples used in learning aim A, or their own examples, for inspiration. Remind learners that, even if they are going to work individually, group discussion and feedback are useful parts of the design process.
- Once learners have considered web application design, you should discuss hosting options. They should understand the cost implications as well as the expandability of the options available. Learners should be aware that websites must be hosted on a server and that the software available on that server will have an impact on the implementation of their web applications. Learners must understand that the choice of host will dictate which scripting languages they can use, what features are available and what bandwidth they can utilise. They should also appreciate that costs will vary.
- Learners must be familiar with software development and the design documentation that is expected of them. Learners must be able to design the purpose, interface, scripting and hosting options for their website. Therefore, they should be confident in the use of diagramming techniques and pseudocode. To build their confidence, learners could investigate a popular website and produce design diagrams and pseudocode to describe the website.
- Encourage learners to present their designs to their peers for review. This could be done on a weekly basis throughout the duration of the project. Feedback should be constructive and learners should refine their designs, as necessary. You could also arrange an opportunity for learners to present their designs to the rest of the class as though pitching to clients. As before, feedback should be constructive and learners should make a note of any potential refinements.

Learning aim C – Develop a web application to meet client requirements

- Show learners how you would go about developing a web application from a design schematic. Learners should be able to produce a prototype of their websites using appropriate tools and techniques. Learners should have the use of several web development environments, tutorials and exercises to aid their progression through the unit so that they can build up their skills related to the development process.
- When covering scripting, you should provide learners with examples of client-side and server-side scripting used in interactive websites.
- Learners should have as much time as possible to work with development tools to develop their skills using both client-side and server-side scripting languages to build interactive websites.
- Discuss how database systems are used and integrated into websites, using real-life

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examples where possible. Learners should have an understanding of the use of SQL to run queries and manipulate data on a database.

- Allow plenty of time for learners to review their own web applications and the web applications of their peers. This should be arranged to happen at a stage where learners have a functional website but still have time to make refinements based on the feedback they receive.
- Discuss with learners why you might test a web application and what sorts of tests you might run. Organise supervised testing workshops so that learners can learn how to conduct various types of test, including compatibility, stability and acceptance. Demonstrate the use of a variety of methods and show how you might rectify common issues that arise as a result of these tests.
- Encourage learners to demonstrate their web applications to an audience. They should also gather feedback from sample users to identify improvements and the overall level of acceptance.
- Discuss the way in which legislation has an impact on web application development. Use specific examples that learners will be able to relate to, such as European Union guidelines on cookies.
- Once they have completed the process of development, learners should reflect on their performance and identify their strengths and any areas for improvement. They should also evaluate their web application against a number of criteria, including the client requirements and their own approach to the project.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 10: Human Computer Interaction*
- *Unit 11: Digital Graphics and Animation*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 14: Computer Games Development*
- *Unit 15: Website Development*
- *Unit 16: Object Oriented Programming*
- *Unit 17: Mobile Apps Development*
- *Unit 18: Relational Database Development*
- *Unit 22: Systems Analysis and Design*
- *Unit 24: Software Development.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- https://www.lucidchart.com
  This is an online diagramming tool.

- https://www.surveymonkey.com
  Lucid Chart online survey tool.
  .
- www.w3schools.com
  This is a web development tutorial site, which offers tutorials for a number of scripting languages.

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Unit 26: Programmable Devices and Controllers

Delivery guidance

Approaching the unit

This internally assessed unit will provide learners with an understanding of control systems that use a microprocessor or microcontroller to coordinate the operation of autonomous systems and a range of input and output devices that such systems employ. There is a great deal of scope for practical activity, with either a hardware kit or software simulation or, ideally, a combination of both. There are many ideas for building simple controls on YouTube together with short videos about how control systems are used in various contexts (such as room control systems for hospitality buildings, storage control systems and waste water systems).

Control systems theory and the associated maths has been kept to an absolute minimum, so as to make the unit engaging for learners whose interest lies more in programming and systems design. Although it does include some underpinning maths, numeric and non-numeric data types and Boolean algebra, the emphasis is on low-level programming, good design principles, handling analogue and digital information and a basic knowledge of simple hardware devices, such as temperature sensors or LED displays.

This unit would suit a tutor with some background interest in electronics/control technology in addition to the fundamentals of computer science. It will appeal to learners who are keen on programming, especially hobbyists. It could also tie in with an extra-curricular 'makers' club.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, learners should investigate a range of different control systems, with the emphasis on real-world systems that they are familiar with, such as a domestic washing machine or a lift. Learners should be able to describe the overall behaviour of these systems in terms of conditional (automatic) behaviour and programmable (user-initiated) behaviour.

Learners need to understand the basic operation of typical hardware devices, how to interpret the characteristics of typical sensors, the difference between analogue, discrete and (binary) digital data, how analogue signals are converted to digital data, how all data is stored in a binary representation and the principles of combinatorial logic. Using a combination of real case studies, technical data sheets and simulation exercises, learners should thoroughly investigate these aspects through practical work, which will include designing hardware and software along with the implementation and testing of low-level program code.

For learning aim B, learners will need to apply their practical experience to design a control system based on detailed requirements that you provide for them. They must be able to create top-level designs for hardware, and more advanced learners should be able to produce block diagrams or circuit schematics. The software design can use one or a combination of techniques, such as flowcharts, state diagrams or pseudocode.

It is also important that the learners understand the need for rigorous testing. Many control systems are ‘safety critical’ in that incorrect operation could result in injury or loss of life. There are many well-known examples of simple software bugs causing disastrous results that learners could study; for example the Mars probe, which was programmed to use a combination of metric and imperial measurements and ended up crashing into the planet.

Learning aim C completes the development cycle, with learners independently programming and testing a control system based on their design work and test planning. The software could be developed and tested in a simulation environment or using a microcontroller kit. The language used could be anything (from assembler to a version of C) but you should avoid software applications that convert flowchart designs into code automatically. Learners must demonstrate an understanding of the basic principles of programming and interfacing.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital to progressing in higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skills, knowledge and behaviours.

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Learning aim	Key content areas	Recommended assessment approach
A Investigate a control system, including its associated hardware, the data processed and how it is represented	**A1** Investigation of input and output devices **A2** Analysis of control system behaviour **A3** Underpinning terminology and maths **A4** Use of different data types and encoding techniques **A5** Properties of analogue and digital signals **A6** Principles of combinatorial logic	A technical report based on a simulation or case study of a commonplace control system, including the use of data sheets and appropriate analysis techniques.
B Design a control system to meet client requirements	**B1** Designing hardware schematics **B2** Designing low-level software **B3** Testing for safety critical systems	A functional control system demonstrated on a simulator and/or a typical programmable device. Supporting documentation, including design work, evidence of testing and an evaluation of the outcomes against client requirements.
C Develop a control system to meet client requirements	**C1** Principles of low level programming **C2** Review the development cycle of a control system	

Assessment guidance

The first assessment activity should cover learning aim A. Learners could compile a technical report or a technical handbook based on a simulation or case study of a 'commonplace control system' such as a drinks vending machine. Learners could select one of the systems that they have investigated or you could direct them to a specific one. The more advanced learners could work on a completely different system to document.

The technical documentation should refer to data sheets for sensors and other devices, where appropriate. The learners should also employ appropriate analysis techniques, use underpinning maths and demonstrate an understanding of how information is collected, represented and stored.

The first assessment develops learners' communication skills. They will be required to present a wide range of technical information in a coherent and well-presented technical document, which could be in the form of a technical handbook (aimed at a specialist or general technical audience). In the process of investigating a range of control systems in preparation for this assessment, there is an opportunity for learners to work in pairs to develop their collaborative working skills.

The pass criteria only require learners to have a basic understanding of the components of a control system, but they should be able to analyse them in terms of analogue sensor characteristics, Boolean logic/truth tables for digital logic and the way in which analogue signals are converted to digital data. For distinction level, the learners will need to evaluate the system in terms of the hardware components that are used, data acquisition, limitations of analogue to digital conversion, and the implications of using a programmable device instead of hard-wired logic.

The second assessment activity should cover learning aims B and C. Learners will be required to design, implement, test and evaluate a simple control system based on detailed requirements provided as part of the brief. They should present this as a portfolio of evidence, which should comprise design work, code listing, test results and an evaluation report. Learners could also demonstrate their working system.

The second assessment encourages the development of cognitive and problem solving skills in the development of a solution to the given problem. There are opportunities for creativity in the design of the hardware (which will not need to be implemented) and the use of the appropriate technology to implement and test their program code. The critical review (U.D3) develops interpersonal skills of self-management and self-development.

The pass criteria require the learners to design, implement and test a simple control system, which may or may not meet all the requirements; how effectively it does this should be discussed in the review. To gain a merit, the learners will be expected to justify their designs using appropriate terminology, making reference to the requirements. They should use their testing to ensure that the system fully meets these requirements. At distinction level, the learners should evaluate the system against the requirements as well as demonstrate their awareness of the process and their application of the employability skills being targeted.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 26: Programmable Devices and Controllers

Introduction

Programmable devices and microcontrollers are everywhere, from domestic appliances to the international space station. From this starting point, you can ask learners to identify as many devices as they can come up with that contain a microprocessor. This may prompt further ideas for case studies.

Learning aim A – Investigate a control system including its associated hardware, the data processed and how it is represented

After making a list of devices that contain a microprocessor, it is important to develop the learners' technical vocabulary and their understanding of the common features and underpinning theory for these control systems. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Introduce learners to typical input and output devices through investigating a range of different control systems. If possible, and ideally, they should have hands-on experience with real devices such as measuring the output from sensors with a multi-meter and comparing with technical data. This also provides a good opportunity to bring in external speakers, such as engineers/technicians who work with control systems, for example the building management system in a local office complex (or even your centre).
- Learners must be able to describe the systems in terms of conditional (automatic) and programmable (user-initiated) behaviour and understand the role of feedback in a closed-loop system to support the conditional behaviour. This should include experience of designing hardware (top-level) as well as designing and implementing the software to run simple systems; learners could do this as paired activities.
- As well as developing fluency in the appropriate terminology for controls systems, programmable devices, sensors and signal conversion/conditioning, learners should also be to describe simple digital circuits in terms of logic gates, truth tables and Boolean algebra. You can use formative assessment tasks to check the learners' progress, asking them to write a brief technical report on one of the systems they have been investigating.

Learning aim B – Design a control system to client requirements

In learning aim B, learners should use the experience gained from investigating a range of control systems, which would include learning how to produce block diagrams or simple circuit schematics and software designs using flowcharts, state diagrams and pseudocode. Learners should then independently design a simple control system to meet a given set of requirements. Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Learners should be competent in using an appropriate design/drawing application to produce clear and unambiguous hardware designs, making use of standard symbols. They should complete a number of practical design exercises based on the systems that they have been investigating to develop this skill.
- Learners should be competent in using an appropriate design/drawing application to

produce clear and unambiguous flowcharts and state diagrams. They must also be able to interpret these diagrams as well as pseudocode to produce working software in the appropriate programming language. They should gain experience of programming a range of example control systems through simulation of the systems they have been investigating.

- Learners must be able to devise an appropriate test plan to verify the safe operation of their control system against the requirements. You could provide them with test plans, following a standard format, for each of the simulation exercises. For the evaluation, they must appreciate the importance of thorough testing and the ethical issues, such as the cost of additional testing against the potential risk to end users. In class discussions, you should consider the risks inherent in the different systems investigated and the issues that a designer, a developer and a commercial organisation would have to consider.

Learning aim C - Develop a control system to meet client requirements

Using their design work and test plans, the learners must be able to independently program, test, improve and evaluate their solution.

- Learners should have experience of writing program code for simulated control systems and/or microcontroller kit. It is strongly recommended that they should use the same language throughout the unit, whether this is assembler or a higher level language such as C or a derivative. It is important that the I/O functionality is not too abstracted or completely hidden. However, the learners should be aware of the range of languages and other methods (e.g. ladder logic) or programming control systems.
- Learners should gain experience of translating designs into program code, with an understanding of data abstraction and data types, test and branch operations, the use of subroutines and specialist I/O instructions. This should also be part of the investigation activity; learners should work individually to do the typing in and testing of the code, even if they carry out the design work in pairs.
- Learners should understand the development life cycle of control systems and the importance of testing for safety. They should also consider the commercial implications, for example balancing development costs against quality and safety.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

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Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 19: Computer Networking*
- *Unit 24: Software Development*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

For this unit, learners may require access to hardware development kits in addition to software simulations, although access to hardware development kits is not a mandatory requirement.

Learners will require access to a software simulation environment in order to complete the practical element of the unit, for example the Microprocessor Simulator – GNU/GPL. See the Websites section below for details.

Textbooks

- Elgar P *Sensors for Measurement and Control* (Prentice Hall, 1998) ISBN 9780582357006
  This is a good introduction to sensors and technical terminology. It is suitable for level 3 learners upwards.
- Kal S *Basic Electronics (Devices, circuits and IT Fundamentals)* (Prentice Hall, 2004) ISBN 9788120319523
  This is a thorough introduction to analogue and digital electronics. It is suitable for level 2 and level 3 learners.
- Margolis M – *Arduino Cookbook, 2nd edition* (O'Reilly Media, 2012) ISBN 9781449313876
  This is a useful teacher reference book and introduction to the Arduino microcontroller and programming. It has a huge range of examples from beginner to advanced level. This is level 3 to level 4 reading for learners.
- Bolton W – *Programmable Logic Controllers*, *6th revised edition* (Newnes, 2015) ISBN 9780128029299
  This is an in-depth introduction to PLCs and ladder logic, as well as a good introduction to control system theory. It is suitable for level 3 learners upwards.
- Lincoln D – *Programming and Customising the PICAXE Microcontroller*, *2nd edition* (McGraw Hill, 2011) ISBN 9780071745543
  This is a good reference guide for the PICAXE, which explains data types and encoding very well. It is aimed at level 3 (electronics) learners.

Websites

- www.arduino.org
  The Arduino Project. This site contains resources for the Arduino Project including IDE and example projects.
- http://uk.rs-online.com
  RS Components. This is a supplier of the Arduino Starter Kit with UNO board.
- www.rapidonline.com
  Rapid Electronics. This is a supplier of the PICAXE-08 Proto Board.
- www.softwareforeducation.com
  Software for Education. This site provides a download of a microprocessor simulator (GNU/GPL) which can be used free of charge by students at an educational institution.

Unit 27: 3D Modelling

Approaching the unit

This internally assessed unit is designed to provide learners with opportunities to explore the computing principles of computer-generated, three-dimensional models. Learners should explore the technical characteristics of how computer systems and users can manipulate and render 3D, to produce solutions for a range of vocational problems. Learners should apply analytical thinking to examine how models can be used to meet a range of needs. They will also need to demonstrate proficiency in creating and manipulating 3D models to develop a solution to an identified problem and meet specific client needs.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could provide some initial information on the general uses of 3D modelling, giving some examples of the industries in which 3D modelling is used, such as the entertainment industry, publishing, architecture, advertising and marketing, gaming, science and geology. Learners should then explore the applications of 3D modelling in different industries through a combination of individual research, group activities, guest speakers and visits. Learners should have a strong grasp of the benefits and drawbacks of 3D modelling in a range of contexts in different industries and across a variety of applications.

Learners should explore how geometric theory is applied to 3D modelling and how the individual features of geometric theory can have an impact on final models. Learners need a good understanding of the computing principles behind 3D modelling and should have opportunities to explore how the features of rendering (A3) affect the final model. They should be able to apply their knowledge of geometric theory and 3D rendering to a range of scenarios and example models and should understand how different features affect the modelled outcomes and the implications for individuals or organisations. Learners need to have experience of using appropriate hardware and software systems to create and manipulate 3D models. They should be able to discuss the importance of different hardware and software components in relation to 3D modelling projects.

Learners should be able to apply their understanding of the techniques and computing principles of 3D modelling in a range of vocational contexts in order to develop analytical and evaluative skills that allow them to identify, select and justify processing and rendering methods in relation to the outcomes of a project.

For learning aim B, learners will need to have a good understanding of the practical skills required (A2, A3 and B1) as well as the underlying theoretical principles. They must be able to provide detailed plans that discuss and justify the selection of techniques and processes to create a complex 3D model for a specific purpose. It would be helpful for learners to spend time developing practical skills in a range of 3D modelling packages. You should provide learners with opportunities to develop and produce models in response to a range of scenarios.

Learners will be required to demonstrate a number of practical project planning and management skills. In preparation for the assignment, you should ensure that learners know how to produce planning documentation that is clear and detailed. They must be familiar with effective methods of communicating with others to seek and record feedback in order to refine ideas. Learners would benefit from developing a personal log which will capture their development experiences and will be a useful aide memoire when seeking to review each part of the development process. You should ensure that learners are aware of the relevant legal and ethical considerations: for example, if the complex model is to be part of a building, then their planning would need to demonstrate an understanding of the relevant health and safety and building regulations.

Learners should be able to demonstrate an understanding of how the mathematical principles and processing techniques used to edit and manipulate 3D models have an impact on the modelled solution, and the implications for the project as a whole.

For learning aim C, learners should develop the practical skills listed (C1 and C2) in a range of realistic vocational scenarios. Learners should spend time developing these skills before attempting the assignment. You should ensure that learners have a good understanding of how to select and apply different testing and review methodologies, create and complete test documentation and work with others to review and refine ideas and outcomes. Learners should be able to select and apply testing methodologies that test, review and optimise their models to ensure that the models meet the specified project success criteria. They will need to review and test their 3D models to ensure that a range of technical and quality characteristics (C4 and C5) are covered.

Learners should be given opportunities to work with others to identify working parameters, success criteria and to review outcomes. It is important that learners can demonstrate the application of all skills in a realistic project environment. It would be very helpful to have engagement with and the assistance of local professionals when delivering the content of this unit. Guest speakers could provide valuable insight into how digital graphics and animation are used in larger projects or could provide examples and case studies relating to the project management skills required in the computing industry.

Throughout their practical work, learners should be encouraged to keep a diary, in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital to progressing in higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Examine the principles and applications of 3D modelling used in different industries	**A1** Applications of 3D modelling used in different industries **A2** Geometric theory **A3** 3D image rendering **A4** 3D modelling development technologies	A report providing information on how 3D modelling is used within different industries, detailing the techniques, processes and technologies involved in producing realistic computer representations of physical objects.
B Design a 3D model to meet client requirements	**B1** 3D modelling design techniques and processes **B2** Design documentation **B3** Reviewing and refining designs	Design schematics showing the planning, preparation and design of a 3D model that meets a client's requirements. A 3D model that fulfils the design schematics, accompanied by supporting development and testing documentation. A report evaluating the 3D model against the design schematics.
C Develop a 3D model to meet client requirements	**C1** Principles of 3D modelling **C2** Developing 3D models **C3** Testing 3D models **C4** Quality characteristics **C5** Skills, knowledge and behaviours	

Assessment guidance

It is recommended that this unit is assessed as two separate assignments. The first assignment should assess learners' understanding of learning aim A and the second assignment should cover learning aims B and C.

The assignment for learning aim A could take the form of a report, based on individual research, covering the use of 3D modelling for different applications in a range of industries. The report should consider the benefits and drawbacks of 3D modelling within the identified industries. Learners should demonstrate an understanding of the way in which geometric theory and 3D image rendering have an impact on the outcomes of a model. There are several ways to do this: for example, learners could include a general discussion of how a particular element of geometric theory affects a 3D model. They could demonstrate deeper understanding through contextual, vocational examples, supported by analysis of the impact of this particular method on the given context. Learners will need to demonstrate an understanding of how additional factors, such as hardware and software technologies, affect the outcomes and delivery of a 3D model. This could be in the form of a written document, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

The assignment for learning aims B and C should take the form of a practical project that provides evidence of planning and developing a 3D model as a solution to a given problem. The scenario for the assignment should provide enough scope to allow the learners to be able to consider different solutions to parts of the problem (such as processing and rendering techniques) and to demonstrate a range of 3D modelling techniques (including moving/interactive components). They should use a range of testing methodologies to ensure that the outcomes meet the project criteria.

It is important that the context for the assignment is realistic, and that learners have a 'client' for whom they are producing graphic and animation files. Learners should work closely with the client throughout the project to review outcomes and time scales. The 'client', where possible, should be a real-world client with whom the learner can engage. While the project might be 'simulated', in that it may not be a live project, it is invaluable to engage with local employers to provide a vocational setting. If real-world clients are not available, a tutor or other adult may simulate the role of 'client'. Other learners should not fulfil the role of client, although they may be test users. It is important that the 'client' has a sound knowledge of the project and the related computing requirements

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 27: 3D Modelling
Introduction 3D modelling plays a key role in many areas of the computing industry as well as other vocational areas. From generating characters and landscapes for an online computer game to designing and testing aircraft, 3D modelling provides designers with the tools to refine complex designs and improve project outcomes. This unit has been designed to provide learners with the skills and understanding to create and manipulate 3D models to solve specific problems. Learners will need to apply practical skills and underpinning knowledge to produce 3D models for a range of purposes. The unit provides learners with project planning, management and analytical skills that can prepare them for a range of apprenticeships, or higher education courses, so that they can eventually enter the workplace as professionals in wide range of computing and vocational areas.
Learning aim A – Examine the principles and applications of 3D modelling used in different industries
• To begin, you could introduce the overall aim of the unit, providing learners with the 'big picture'. Explain that they will be required to produce two assignments: one that concentrates on learning aim A and one that focuses on learning aims B and C. • You should provide learners with some initial information on the theoretical concepts of 3D modelling, including the industries in which it is used and the applications of 3D modelling to different vocational contexts. For example, in geology, scientists can use modelling to simulate earthquakes or tsunamis which occur when there are under-sea eruptions or sudden drops in the ocean floor. • Guest speakers from, and visits to, local employers would provide invaluable support to individual and classroom activities when exploring the nature of 3D modelling in different contexts. This would provide learners with opportunities to get a clear understanding of the tasks that need to be performed and how 3D modelling fits into larger projects. • Learners should explore geometric theory and should have a good understanding of how it can be applied to computer-generated 3D models. One example could be how 3D graphics, geometry, transformations and vectors are used in first-person shooting games. Following some input from you and research into the computing and mathematical principles, learners should develop their understanding through practical examples. You should provide opportunities for learners to explore, apply and manipulate features of 3D models to see the effects of different aspects of geometric theory. • For learning aim A3, learners need to understand the implications of using 3D models to represent physical objects. You should provide learners with opportunities to explore features of computer-generated models and the different types of techniques used within computer systems to render 3D models. Learners should be able to analyse the use of different principles and techniques and discuss the outcomes and implications associated with each within different contexts. It would be useful for learners to explore these through hands-on practical tasks. • Learners should explore the impact that different technologies have on the creation,

manipulation, use and delivery of 3D models. Learners should explore the different types of hardware and software that can be used to create and deliver models and how the features and limitations of these technologies affect the final model and the project as a whole.

- Learners should be able to contextualise all subject matter so you should provide opportunities to develop their analytical and evaluative skills by exploring the effects of using digital graphics and animation within different contexts. Learners should understand how and why different processes are used and be able to select different process to meet identified needs, justifying their choices.

Learning aim B – Design a 3D model to meet client requirements

Learners should possess a range of skills and be competent in their understanding before starting the assignment. You should not use the assignment as a vehicle to teach the content.

- You should provide learners with opportunities to develop the practical application of a range of 3D modelling processes and techniques (B1). The list of potential objects that could be created using 3D modelling is vast and could include household objects such as mugs, a new kitchen tool, something scientific like a model of our immediate solar system, a new toy, a child's game (such as shapes that need to be fitted together) or a new aid for someone with a disability. It is important that learners have a good understanding of what can, or cannot, be done, as well as having realistic ideas of the resources and timings required, before they start to plan a project. You should provide learners with introductions to software-specific skills, which they can develop through tasks requiring them to respond to realistic, vocational scenarios.
- For B2, you should teach learners how to use a range of planning documents to identify user requirements, plan the development process (including sketches of initial ideas, relevant notes that outline the tools and techniques they will use and timescales) and identify and set success criteria/project parameters. Documentation for this unit will vary and learners need to know about the different styles of document, in varying levels of detail, depending on the situation/project. However, it is likely that most, if not all, areas listed in learning aim B2 should be included to a greater or lesser extent. Learners must be aware that planning documents should be clear and detailed and provide a vehicle for discussion with the client (and other relevant parties) to ensure that the project is efficient and outcomes are accurate. They should understand that a project of this type is about what the client wants, not about what they want to create and, while they would clearly be expected to input their ideas into the process, the final decisions are not theirs. As a general guide, planning documents should be sufficiently detailed so that (as may be the case in a real-world situation) a third party could take the planning documentation and continue with the project without any input from the original designer.
- Learners should be able to provide evidence, using their planning and development documentation, that appropriate legislation and professional guidelines have been taken into consideration. They do not need detailed understanding of a wide range of different legislation, but learners should provide evidence that they have considered essential points of legislation that are appropriate to their project. For example, a model designed to simulate a room in a building would need to take account of appropriate regulations and legislation. They could provide evidence of this through annotation of design documents and/or discussion in reviews as to why, for example, certain materials or particular dimensions were used.
- In order to develop strong vocational and employability skills, you must ensure that learners know how to manage projects effectively. This will include organising meetings with a client, recording outcomes from meetings and other forms of

feedback, and adjusting plans and timescales for the project as appropriate.

- You should work with learners to ensure that they develop effective and appropriate communication skills. All project documents and communication with clients should use the appropriate style, tone and content.

Learning aim C – Develop a 3D model to meet client requirements

This learning aim should flow naturally from learning aim B. Learners will need to be able to apply this understanding as part of a larger project. Learners should be competent in a range of practical skills and associated theoretical knowledge before starting the assignment. You should not use the assignment as a vehicle to teach the content.

- For learning aims C1 and C2, learners will need opportunities to develop the associated practical skills within a range of contexts. Learners should have a solid understanding of the way in which the use of appropriate hardware and software, and associated tools and techniques, can affect a project. Learners should be able to select and apply appropriate tools and techniques to develop a 3D model to meet identified client needs. Learners should understand that, at this level, they must be able to clearly articulate and potentially defend their choices.
- Learners should be able to demonstrate an understanding of how to apply mathematical and computational principles in order to ensure that models meet client requirements and the associated implications of applying these techniques. They can demonstrate this in many ways and it is likely to be a multi-stage process. For example, details of geometric primitives, rotations and rendering processes used in the model could be included in the design documentation, whereas the discussion and justification for their use could be presented elsewhere, such as in communications with the client or review documents.
- Learners should be able to select appropriate testing methodologies so that outcomes can be thoroughly tested and reviewed. They should be able to appropriately and thoroughly plan and document their selected testing processes, ensuring that the outcomes of their testing are clearly recorded. Learners should know about, and understand, a range of formative and summative testing and review methods. They should be able to appropriately select, apply and justify the use of these to ensure that the outcomes of the project meet the needs of the identified client.
- To develop learners' understanding of the testing and review process, you could provide learners with practical activities in which they need to test and review 3D models created by others (and associated project criteria), while identifying areas for development and ways of improving the files. It would be helpful for learners to have access to editable versions of the files so that they can explore the tools and techniques used, and make adjustments and improvements, as necessary.
- You should work with learners to develop their evaluative skills. Learners should be able to use the outcomes of testing and review to evaluate the quality of solutions (and their own performance, as appropriate) against project requirements and client expectations. Peer critique is also a useful tool and should be a supportive process with learners encouraged to find ways of giving sometimes negative feedback in a positive way.
- It is also important to work with learners to ensure that they develop effective and appropriate presentation skills. All project documents and communication with clients should use appropriate style, tone and content.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should

also note the comments that their peers make when they give feedback.

- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 11: Digital Graphics and Animation*
- *Unit 14: Computer Games Development*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Websites

- www.cs.cf.ac.uk/Dave/Multimedia/node189.html
  This is an academic website for arrays and digital image representation.
- www.digitaltutors.com/subject/3d-modeling-tutorials
  Pluralsight. This site provides tutorials on using a range of different 3D modelling software programmes.
- www.blender.org
  The Blender foundation. This site has open-source 3D modelling and animation software. It includes free open-source software and tutorials.
- www.digitalartsonline.co.uk
  This is an online magazine dedicated to digital graphics, animations and associated fields. It contains features, reviews guides and tutorials.
- www.hongkiat.com/blog/25-free-3d-modelling-applications-you-should-not-miss
  This is a list of free and/or open-source 3D modelling software programs and includes links to developers' websites.

Unit 28: Computer Forensics

Delivery guidance

Approaching the unit

With cybercrime on the rise, computer forensics is an important and dynamic area. It is also quite a complex and technical area and the learners will have little experience of some of the topics covered in this unit. However, it is a fascinating topic and can turn into something of a 'cat and mouse' game between the criminals and the forensic investigator. One of the challenges of this unit is that many learners will have preconceived ideas of the job of a forensic investigator from TV and films; they may not understand that the work needs to be carried out in a meticulous fashion and that it is essential to follow correct procedures.

You should also bear in mind that there are quite a lot of resources needed for the practical aspects of the unit. It is important to plan well ahead, so you can have everything set up in good time. There are limited opportunities to engage with employers in this subject area although the number of computer forensic/digital investigation companies in the UK is rising. Local law enforcement will certainly be able to share strategies and provide an insight into the challenges of the industry.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

Learning aim A involves some topics such as the courts, law and evidence and the learners may have little experience of this subject area. Some research may be needed and, if possible, try to arrange for an external speaker, from the police or a legal professional, to come and explain some of the content to learners. Learners might also have some preconceived ideas of forensic procedures (from TV programmes etc.) so you need to make sure that they understand the vital importance of procedures and processes and the consequences of not following them.

Learning aim B is practical in nature so will require some particular resources in terms of hardware and software as well as some effort in setting up the systems. It is highly unlikely that learners will be allowed to investigate the internal working of the live computing systems within your school or college. This means there are two options. You could:

- have separate, dedicated, unrestricted computer systems and networks which are not directly connected to your centre's main system
- use virtual PCs. There are various software products available that allow you to install a software-emulated virtual PC, for example VirtualBox.

Learning aim C is also practical and you will need to do some preparation in advance to create systems for learners to investigate. You will also need to create some more detailed case studies, perhaps extending some of the ones you used for learning aim B. Learners will need plenty of opportunity to develop and practise their practical skills ready for the final assessment.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Examine the legal and professional framework surrounding computer forensics practice	**A1** Current legislation, legal bodies and types of crime **A2** Forensic documentation, case notes and evidence requirements **A3** Preserving the crime scene	An exploratory project in the form of a briefing document or report, investigating and evaluating the role of current legal and professional practices applicable to computer forensics.
B Apply current computer forensic technologies and investigative techniques	**B1** Desktop forensics **B2** Network forensics **B3** Mobile forensics	A practical forensic activity applying relevant current forensic techniques (desktop, network and mobile) to a piece of evidence, which must be conducted in a professional and legally admissible manner. Evidence of the investigation in the form of a briefing document.
C Carry out a computer forensic investigation on a suspect system	**C1** Establishing forensic protocol **C2** Establishing investigative terms of reference **C3** Systematic analysis of a suspect system **C4** Critically reviewing findings	A briefing document and practical evidence to confirm that a computer forensic investigation has been carried out on a suspect system. Supporting documentation in the form of a valid forensic protocol, documentation of key stages of the investigation and all relevant contemporaneous notes.

Assessment guidance

This is an internally assessed unit, and learners will need to complete two assignments that will need to be devised and marked internally. The first assignment will assess learners' understanding of learning aim A and the second will cover learning aims B and C.

Learning aim A is theoretical so learners will need to produce a report or briefing document, focusing on the role of current legal and professional practices that apply to computer forensics. This could be in the form of a written document, but a blog or some form of audio or visual evidence would also be acceptable and would allow learners to develop their creativity, provided the information is communicated in a clear and detailed manner using appropriate language.

For learning aim B, learners must provide evidence that they have used forensic investigation techniques on desktop, network and mobile systems. This evidence is likely to be in the form of photographs, screenshots and witness testimonies. Learning aim C is also practical and learners will need to provide evidence of the forensic investigation that they have carried out, including documentation of all stages of the investigation such as photographs and screenshots. You will need to consider how to provide a suitable scenario for the assessment.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 28: Computer Forensics
Introduction This unit contains quite a lot of material which is likely to be new to learners, especially the content relating to the law, courts and evidence.
Learning aim A – Examine the legal and professional framework surrounding computer forensics practice
Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● If possible, try to arrange a visiting speaker to talk about evidence requirements, how the courts work and legal issues, as this might be a little outside your experience and external speakers can add a degree of reality to the explanations. There might also be an opportunity to attend a local court session as observers, not necessarily in relation to computing (although this would obviously be of benefit), but to enable learners to understand the importance of evidence and evidentiary management. It would be helpful to find someone from the police (who can be keen to work with the community), the courts or a local law firm specialising in criminal law. Such a speaker does not really need to cover computer-related crime specifically, but they need to be able to provide sufficient detail to cover the content in A1. The associated assessment criterion is AP1, which requires each learner to explain legislation and legal bodies. Learners need to develop sufficient understanding to go beyond a mere description and provide some reasons as to why the legislation and legal regulations and bodies are in place. ● Learners could work in small groups to research cases where computer-related crime has taken place. In July 2016, fraud (usually relating to computer activity) was declared to be the most prolific crime in the UK. In fact, in 2015 there were on average 112 instances of fraud per 1000 adults in the UK. In addition, there were 54 cases of computer misuse in the same period. There are many statistics available on the web (tutors should use some of the many government websites that provide information on this). Learners should look at how the crime was committed, how it was discovered and how evidence was collected and used. There are many different computer forensic case studies available on the internet; see the resources section for some suggestions. ● Learners will need practice in understanding the use and importance of forensic documentation and case notes. They can, of course, research the types of documentation listed in the content on the internet, but it might be useful for learners to create their own versions of the documentation, as if they were freelance computer forensic investigators. It would also be a good idea for learners to practise using these documents in some simple simulated crime scenes, which also gives them the opportunity to practise the process of preserving a crime scene. These do not necessarily have to be computer crime scenes, although something simple, such as the theft of a laptop containing important data, could be an effective scenario. Learners should understand that the loss of a device containing data is not in itself a crime (although it may well breach company policies) – the crime is when someone finds the data and chooses to use it for an illegal purpose. ● It might be difficult to set up a physical crime scene for all the learners to observe and document, so one alternative is to create a crime scene video, which learners

can watch before completing their documentation. These activities relate to AP2 and AP3, both of which require the learners to provide explanations, so simple descriptions of the documentation and techniques used to preserve the crime scene will not be sufficient. Learners need to understand why the documentation and techniques are used. ● When you are confident that learners have a full understanding of the legal and professional framework surrounding computer forensics, you can issue the first assignment brief.
Learning aim B – Apply current computer forensic technologies and investigative techniques
Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● You will need to arrange computing equipment with which learners can practise. This equipment includes desktop computers, network equipment and mobile devices. These need to be set up in a way that learners can apply forensic techniques to them. This does not necessarily mean that the devices should contain evidence that they have been compromised in some way, but learners should be able to identify things like who logged on when and what files they accessed. This can be organised with either real physical computers or virtual ones. Ideally, you will need to create system images of a system in a suitable state for investigation and then apply them to multiple real or virtual machines that the learners can investigate. ● You need to help learners develop skills in justifying and evaluating their use of forensic techniques and tools. At first, learners will just apply the tools and techniques you have demonstrated, but, once they have the basic skills, you can encourage them to think about why they are using a particular tool. They need to fully understand what they are trying to achieve and which tool is likely to help them achieve it. Try to provide learners with case studies that are quite specific so that they can choose the right tool or technique. When they have carried out an investigation, encourage learners to review how it went. Learners will need to justify and evaluate the use of desktop, network and mobile forensic techniques in order to achieve merit and distinction levels for this learning aim.
Learning aim C – Carry out a computer forensic investigation on a suspect system
● This learning aims extends the use of individual forensic technologies covered in learning aim B to the complete forensic investigation of a suspect system, including the development of a forensic protocol, use of documentation and tools. You will therefore need to provide case study 'suspect' systems on which learners can practise their documenting and investigating skills. This will require more detail than the systems you provided for learning aim B, in that you need to produce case studies that provide learners with opportunities to cover C1 (establishing a forensic protocol) and C2 (establishing terms of reference). ● Learners can apply the things they have learnt in learning aims A and B to this learning aim. They can use the documentation that they created in learning aim A and the tools and techniques they practised in learning aim B when honing their investigation techniques. You may be able to use some of the case studies used in learning aim B but extend them to include a crime scene. The case studies should provide sufficient detail for learners to cover all the required skills. For example, you might create a scenario where there has been a

break-in to a company director's office and there is a suspicion that the director's laptop may have been accessed and important data copied. Remember that you will need to have on-file auditing (for Windows) to set up the computer.

- One activity that may help to enthuse and motivate learners, and help them develop the skills in analysing and evaluating their actions (as needed for CM3 and CD3), is to run a mock courtroom. In this activity, a learner plays the part of an expert witness presenting their evidence in court. The most important role in the activity is that of the defence lawyer who cross-examines the expert witness, a role that you could play. The aim of the defence lawyer is to discredit the expert witness and their evidence. This will require the learner to justify the actions they took during their investigations of the suspect system. Through this kind of activity, learners should understand the importance of effective advance preparation and the need to ensure that they fully understand the evidence and the context.
- Another way in which you can help learners to develop skills in evaluating their work is to encourage them to keep notes or a diary as they practise the skills required. These notes can be paper-based or electronic; they could even keep a blog of their progress. The notes can help them to identify their thought processes at the time, as these are often difficult to recall later. Learners can then use these notes in the final assessment. You can also help the learners in this respect by asking them to explain, during practical sessions, why they are doing certain things, and how what they are doing will help them to discover what happened. You need to insist on learners providing detailed answers, and should encourage them to write the answers in their notes.
- When you are confident that learners have a full understanding of how to carry out a computer forensic investigation on a suspect system, you can issue the second assignment brief.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 1: Principles of Computer Science*
- *Unit 2: Fundamentals of Computer Systems*
- *Unit 6: IT Systems Security*
- *Unit 7: IT Systems Security and Encryption*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in IT. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Sammons J – *The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics* (Syngress, 2012) ISBN 9781597496612
  This is an introduction to forensic techniques that is quite easy to read and not too technical.
- Casey E – *Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet* (Academic Press, 2011)
  ISBN 9780123742681
  This is a comprehensive book from an acknowledged expert and contains references to real-world scenarios.
- Murdoch D – *Blue Team Handbook: Incident Response Edition: A condensed field guide for the Cyber Security Incident Responder* (CreateSpace, 2014)
  ISBN 9781500734756
  This is an up-to-date guide to incidence response.

Websites

- www.computerevidence.co.uk/Cases/CMA.htm
  This website provides information on convictions under the Computer Misuse Act.
- http://resources.infosecinstitute.com/computer-forensics-investigation-case-study/
  Case studies of computer forensic investigations.
- www.burgessforensics.com/case_studies.php
  Case studies of computer forensic investigations (US-based).
- www.crime-scene-investigator.net/index.html
  This US-based site provides lots of information about US crime scene procedures.

/https://en.wikipedia.org/wiki/List_of_digital_forensics_tools
This site provides a list of common digital forensic tools, many of which are available under a GPL licence (i.e. free to use).

Unit 29: Network Operating Systems

Delivery guidance

Approaching the unit

Network operating systems are the underpinning foundation of the modern computing era; it is likely that, no matter what direction your learners take after their qualification, they will encounter and work with them. This is an exciting area of computing, that is constantly changing and which has new technology being implemented all the time. Your learners will gain the experience and skills to work with and maintain a range of network operating systems and it is essential to make good use of the newest releases of software.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

For learning aim A, you could begin with a research activity to identify the NOSs (network operating systems) in use today; this can then lead to experimentation and exploration of a range of different operating systems. You should ensure that learners learn about the administration and configuration of operating systems very early on in order for them to have sufficient time to develop their skills fully. These practical activities at this stage will be essential for consolidating their learning of the range of NOS software.

The easiest way for learners to access different types of NOS is through using virtual machines. It is logical to do this as it allows learners to progress from session to session and it also reduces load on resource requirements. It is, however, important that learners gain experience of physical servers and, where possible, experience a physical network and users in a lab environment.

Security plays a big part of learning aim A. As such, it should be a constant theme to the learning to encourage learners to be aware of security from the outset and not simply as an 'add on'.

Learning aim B moves on to the implementation of a secure NOS. The experimentation and skills developed in learning aim A will be invaluable in helping learners to understand the different aspects of implanting a NOS. Learners should be capable of analysing a requirement and proposing a suitable solution. This can be implemented in any full NOS available but it is important that it is not a 'desktop OS' that has network features. A key focus of this aim is again security, and learners need to be aware of issues and responses in this area.

Learners are required to install their own NOS so it is important to consider resource requirements to ensure that all learners have fair access. The use of a virtual machine (VM) is likely to be the most practical way of managing this.

Learning aim C is concerned with the testing, review and evaluation of the activities in learning aim B. Learners will need to be aware of a range of testing strategies and techniques and how these work to meet the initial requirements. They need to include suitable testing of both services and configuration (i.e.

security). A good learning activity in this area could be a range of challenge-type activities through which you ask learners to try to 'break' or penetrate a given configuration.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to articulate their ideas and justify chosen solutions. Learners must be also able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Examine the implementation, features and services of network operating systems</td><td>A1 Current network operating system (NOS)
A2 Server implementations
A3 User management features
A4 Security features and services
A5 Network management services
A6 Specialist services</td><td>A report, briefing document or presentation investigating and evaluating current NOS, features and services.</td></tr>
<tr><td>B Implement a secure network operating system</td><td>B1 Planning a NOS implementation
B2 Installation of a NOS
B3 Implementation of services</td><td rowspan="2">Documentation (such as screenshots, photographs and test plans) showing the planning, implementation and configuring of a NOS to meet identified requirements.
Presentation of a functional NOS with supporting development and testing documentation in the form of screenshots, photographs and logs.
A report evaluating the NOS against the identified requirements.</td></tr>
<tr><td>C Review the implemented network operating system</td><td>C1 Devising a testing protocol
C2 Testing the NOS and implemented services
C3 Reviewing test results against original design expectations
C4 Skills, knowledge and behaviours</td></tr>
</table>

Assessment guidance

This is an internally assessed unit; that is, learners need to complete assignments that are devised/customised and marked by your centre. There is a mandatory requirement of two assignments: Assignment 1 covering learning aim A and Assignment 2 covering learning aims B and C.

Learning aim A is theoretical and a good scenario will guide learners to look at a range of NOSs to meet the needs of the organisation. A report or recommendation would address this learning aim but it can be quite a dry method of assessment. Evidence such as a presentation, promotional proposal material or customised sales brochures are equally valid and can offer learners a more exciting method of assessment, provided the information is communicated in a clear and detailed manner using appropriate language.

Learning aims B and C need to be assessed through a common assignment and both relate to the implementation, testing and review of a NOS for a given situation. Where possible, it can be useful to carry forward the scenario from learning aim A to provide consistency and allow learners to build on the knowledge gained. Learners are required to install a true network operating system and configure it to meet the requirements. To enable learners to produce the best evidence, it is necessary to give careful consideration to the requirements in the scenario so that it leads to a potential solution that is neither too complex not too simplistic.

The ‘server’ can be a physical server or be virtualised. It is likely that, given the demands on resources, a virtualised solution will be more practical to implement. This should not be seen as belittling the task as it is increasingly common in industry now to encounter virtualised servers.

The assessment allows learners to provide evidence of essential skills for employers in the technology sector. Beyond the obvious skills of implementing and configuring a NOS, learners will also develop their communication skills when gaining user requirements and their self-confidence in selecting the correct solution when problem solving.

The assessment criteria logically introduce higher-level skills as they progress. For learning aim A, learners who merely explain the aspects of the unit content achieve the pass criteria; those who go further and analyse the features will achieve a merit; and if they then go on to evaluate the NOS in detail against the identified requirements for an organisation, they can achieve distinction. Likewise, for the second assessment for learning aims B and C. Simply stating the facts achieves a pass grade, analysing the solution gains a merit and being able to explain why they took a particular approach and justify its use in detail against the identified requirements will gain distinction..

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 29: Network Operating Systems

Introduction

Network operating systems surround us in today's computing environment. This unit provides learners with the skills and understanding to implement and secure these systems to support users and services across diverse networks.

Learning aim A – Examine the implementation, features and services of network operating systems

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- To begin, learners could research what NOSs they encounter on a daily basis, to include the features that each offers and what hardware they support. They will need guidance on what constitutes a NOS as opposed to a desktop OS and their frame of reference should extend beyond Windows.
- Divide the learners into small groups to research a particular NOS, along with specific technologies. Each group could then prepare and produce a presentation on a particular NOS and its associated technology. Ensure that there is an equal spread across the group and address each of the NOSs listed in A1 (or their latest equivalent) as a minimum. You should direct learners to include the services each offer to ensure coverage of each element of A2. The tutor can ask direct questions to ensure full coverage of A1 and A2 if any gaps are apparent.
- To develop learners' understanding of A2, put learners into groups and ask them to produce a spider chart of NOS services. They can highlight different services provided by a NOS and explain how they fit into an organisation. Through this approach, they can develop their understanding of the difference between those services that are 'enablers' and those that provide a direct service to the end user. You should suggest relevant examples such as Google Docs and Office 365; learners may be using some of these already.
- Following from A2, it would be logical for learners to develop their understanding of services by looking into the network services and specialist services that are listed in A5 and A6, again identifying these as enabling services rather than user facing and stating the role they play. It would be a good approach to refer to a familiar environment such as the centre's systems, coupled with an investigation of cloud-based technologies that offer, for example, load balancing or dynamic loading.
- This is a good opportunity to gain the expertise of suitably qualified individuals such as an MCP or Cisco specialist to discuss what each proprietary system brings to their own implementation of a NOS. You could develop this into a mini-conference with a range of speakers. You could also consider working with neighbouring centres in your area to make this a more cost-effective activity.
- For A3, again an investigation of the centre's own systems is often a good approach as it is a familiar environment. Learners should understand the inherent need for security in a NOS and the various user groups and levels that facilitate this. A4 logically follows this by investigating wider security measures. Learners could look at recent topical breaches and what methods could have been implemented to prevent or curtail these.

- Running alongside the points above, it is recommended that learners build skills in using and configuring NOSs of different types to enhance their range of skills on offer in preparation for further study or employment.
- When you are confident that learners have a full understanding of the features and services of a NOS, you can issue the first assignment brief.

Learning aim B – Implement a secure network operating system

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- Learning aim B is concerned with the practical aspect of the implementation of a **secure** NOS. Learners can continue to build on the skills they developed during learning aim A to both select and implement a NOS in workshop sessions. It would be useful to run a programme of progressive practical workshops alongside theory lessons, with each workshop building on the skills of the previous one. The combination of theory and practical lessons would be an excellent way for learners to get hands-on experience and to develop skills that build up their confidence as they approach the assessment.
- You will need to provide learners with a number of scenarios so that they can work in groups to select the most suitable NOS, based on the information in the scenarios. They should then look at the different versions of NOSs that can be tailored to suit different markets/loads/users.
- As the main focus of learning aim B is the practical aspect of the implementation of a **secure** NOS, learners should understand the security issues in all aspects of the work completed. To make optimum use of scarce resources, it is likely that VMs will be the best method for this aspect of the unit. Although they will be working together in small groups, each learner should be responsible for their own configuration during the work: i.e. everyone should make a contribution to the implementation. (Clearly, this is mandatory for the assessment activities.)
- Installing a server is only part of the job; beyond this, learners will benefit enormously from the opportunity to configure specialist services running on their server. This can then be tested with the VM or, equally, on a real lab network.
- If resources allow, it would be most helpful to have access to a full lab situation with a physical server, along with a number of clients, as this will really enhance this aspect of the unit for learners.
- It is vital that learners all have the opportunity to perform a 'dry-run' of their installation before assessment so that they can build up their skills and have the opportunity to put right any misconceptions and mistakes.

Learning aim C – Review the implemented network operating system

- Learning aim C revolves around user acceptance and commissioning of a system following thorough testing methodologies. Again, it would be beneficial for learners to continue with the scenario from learning aims A and B to help with their acceptance and understanding of the process.
- A useful option here would be to invite a network manager from a local business, or even the centre's own IT team, to discuss with learners what testing means to them, and how important it is in the real world. Learners often view testing as an extra, or something that is not vital and sometimes even unnecessary, and they do not give it as much focus as it deserves. A speaker could also highlight the critical requirements, and review how they are measured, and explain how their

organisation works to ensure customer satisfaction.

- A good activity at this point would be to provide details of a range of NOS installations. You could ask the learners to identify what, if any, amendments should be made to meet the defined need and then to produce an action plan. It would be useful if you could provide examples that have led to documented downtime, breaches or issues that learners can then investigate and comment on. Learners should see this type of investigation as an ongoing personal development activity (and they will need to continue to do this even when working – there is always something new to learn).
- Following this, you could provide learners with a list of peer or user reviews and organise a class discussion to draw out which aspects people were unhappy with and try to identify potential areas in which improvements could be made. Learners could then divide into smaller groups to produce a detailed evaluative document based on the reviews of others.
- When you are confident that learners have a full understanding of how to implement a secure network operating system, you can issue the second assignment brief.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 19: Computer Networking*
- *Unit 20: Managing and Supporting Systems*
- *Unit 21: Virtualisation*
- *Unit 30: Communication Technologies*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Traver C and Watson R – *Introduction to Network Operating System* (John Wiley & Sons, 2007) ISBN 9780470101872
  This book gives a good overview of a range of different NOSs rather than focusing on a specific system. It is a good starting point for further research.

Websites

- www.microsoft.com/oem/en/products/servers/Pages/index.aspx
  Microsoft® Servers – an overview of Microsoft's current server portfolio.
- www.linux.com
  Linux.com – a source for all Linux-related information and support.
- www.apple.com/osx
  Mac OS® X – gives information on the MacOS network OS.
- www.microsoft.com/Virtualization
  Microsoft® Virtualisation – Microsoft's virtualisation offering for servers. (HyperV)
- home.mcafee.com/advicecenter
  Citrix® ZenServer – optimised server virtualisation.
- www.vmware.com
  VMWare – provides industry-standard virtualisation platform information and support.
- www.virtualbox.org
  VirtualBox® – this is a free open-source product that allows you to install a software-emulated virtual PC.

Unit 30: Communication Technologies

Delivery guidance

Approaching the unit

Data communication is a mandatory unit designed to help learners understand and apply this key element of modern life. Data communication plays an integral part in many social, educational, commercial and entertainment transactions. Your learners are likely to use a variety of electronic devices, relying on data travelling at the speed of light across multiple connections, using different methods.

Your learners will be inspired by being exposed to multiple devices which enhance the theory you teach and bring reality to the classroom. Involving learners in 'show and tell' type activities will help extend access to different resources and enable them to express their previous knowledge and experience to theoretical concepts. Those learners with limited access to resources can be encouraged to partner others or seek out employer-mentors who might be able to help.

Your learners are likely to know little about the theoretical side of data communication despite having been born into a technological world. As an applied, vocational qualification, learners will benefit from multiple opportunities where they can learn by doing, applying and making mistakes.

Since a comprehensive knowledge of communication technologies is required for a career in any computer science discipline, this unit supports progression into any career in computing, including programming or entry into network engineering. This unit will also be relevant to data communication modules on many computer science and related degree courses.

This unit requires each learner to develop the ability to analyse, evaluate and problem solve. They will need to be able to distinguish between advantages and disadvantages to support their arguments. The more opportunities they have to apply these skills, the greater their progress and higher marks they will achieve in the assessments. It might be useful to introduce different techniques to help learners evaluate their skills, for example, by using a SWOT analysis.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

To provide your learners with every opportunity to apply theory to practice, here are some suggestions and ideas for you to consider when planning your lessons, structured around each learning aim.

For learning aim A, learners need to understand data transmission and the technologies used for it. Your learners will find it useful to build up a glossary of terminology to break down the barriers that could affect their progress. They should also be encouraged to make notes that outline the steps of particular processes, as these documents will form a personal development library for future use. This could be an activity in small groups that is ongoing throughout the unit.

If workshops are unavailable at times when practical activities would be beneficial, then small-group activities, such as identifying different types of cables and researching why they are different and proposing where they might be used, can be undertaken easily in a classroom setting. Learners value being able to touch and feel, rather than only look at pictures or listen to explanations. These types of activities are far more likely to remain memorable and help reinforce and develop understanding in topics such as subsections A1 and A4.

In *Unit 1: Information Technology Systems*, your learners will have learnt about lossless compression and can make connections with Huffman and Manchester encoding. As there are direct links to *Unit 19: Computer Networking*, *Unit 20: Managing and Supporting Systems* and *Unit 21: Virtualisation*, you may be able to combine teaching and assessment with these units to avoid duplication. There are opportunities, throughout this learning aim, for learners to contextualise maths and functional skills.

Subsection A3 involves making connections, and there may be scope for coordinating with electronic engineering workshops so that learners can learn from peers they may not usually encounter. Investigations into ISP connections can be initiated, in preparation for coming to lessons. Learners can explain to their peers while you identify any gaps in their comprehension of concepts.

For learning aim B, learners will need to investigate the implementation of communication technologies. Learners will need to be given ample opportunity to explore the different ways in which communication is enabled via the various types of network structures and systems used to support communication.

Allocate time for them to investigate, problem solve and make mistakes; either by taking old network systems apart or trying to rebuild them. This will empower them to learn. This is just one method which will afford you more time to ask them questions, listen to their reasoning and differentiate the group structures.

As your learners build in confidence to speak up, learn from others and not be embarrassed when they make errors, they will develop their cognitive processes along with their employability skills and respect for others.

Learners retain information by applying it to practice, so small-group projects are useful, especially where these are realistic rather than simulated. For example, you could divide the class into several small groups and each group could take on a different aspect of a project relating to the specification, perhaps relating to each subsection (B1, B2, B3, B4, B5 and B6). You might spread this over several lessons in conjunction with other topics, and learners would get a taste of job roles, hierarchy, teamwork and managing conflict. A similar activity might help them to focus on their future career or learning aspirations.

Projects and activities could be coordinated with your IT department or by linking with local employer links through your Employer Business Partnership.

For learning aim C, learners need to implement a pervasive technology solution using communication technologies. This unit provides scope for working with small, medium or large employers. Some of the learners may be thinking of working for themselves in the future while others may have part-time jobs or family members with their own businesses. These examples could provide opportunities for initiating a real-life project on a small scale.

Another activity might include setting up a central server at home, perhaps to stream music around the house or maybe a remotely operated household management system for a neighbour or relative. Students could devise their own app or produce one to support their business idea.

Other projects could be contextualised to interests or hobbies, such as mountain biking, football or landscape gardening. Automated systems can be developed, such as a technologically operated garden water feature or wildlife monitoring webcam station.

Throughout this unit, the activities and tasks in lessons and assignments should build upon each individual's skills, knowledge and behaviours and, as far as possible, some of their personal interests. You might find learners respond well to evaluating their own performance and gradually becoming peer evaluators. It is highly possible that learners will want to resist this at first as it might not be something they are familiar with doing, or have not done since school. However, if your expectations are made evident right from the start and the benefits of doing so explained, they are more likely to respond positively and become ready for higher education and employment.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital for progression into higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcome, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Understand data transmission and the technologies used</td><td>A1 Signalling methods
A2 Transmission media
A3 Making the connection
A4 Network communication devices</td><td rowspan="2">An exploratory report investigating current transmission methods, devices used and systems that make use of communications technologies.</td></tr>
<tr><td>B Investigate the implementation of communication technologies</td><td>B1 Network infrastructure
B2 The internet
B3 Mobile communications
B4 Protocols
B5 Entertainment and social communication
B6 Pervasive and integrated technologies</td></tr>
<tr><td>C Implement a pervasive technology solution using communication technologies</td><td>C1 Designing a pervasive communication technology solution C2 Creating a pervasive technology solution
C3 Testing a pervasive technology solution
C4 Reviewing the development process and outcomes
C5 Skills, knowledge and behaviours</td><td>Completion of a practical activity, that involves designing, creating and testing a pervasive technology solution. It should be accompanied by design documentation, including annotated photographs and screenshots of the implemented design, completed test plans, notes and annotated screen shot of optimisations made. It should also include a report evaluating the process and outcomes.</td></tr>
</table>

Assessment guidance

As this is an internally assessed unit, you will devise your own assignments. It is recommended that learners should be assessed by means of two assignments: the first should cover learning aims A and B and the second should cover learning aim C.

It is helpful to plan the timing with colleagues who are teaching other units to make sure that learners are not overburdened with assignments at the same time or being asked to repeat assessments or produce duplicate products. It may be possible for learners to make use of work that they have carried out in other related units.

It is common for learners to be asked to give presentations or produce written reports, which can be repetitive and uninspiring. Your learners might prefer to present their outputs in a different way, by choosing from a selection of ideas on the assignment brief, for example video recordings, logs, diaries, discussion boards, blogs, testimonials, verbal and written accounts, provided the information is communicated in a clear and detailed manner using appropriate language. You can combine this with the Recommended assessment approach in the table on the previous page.

Your learners will benefit greatly from your confidence in their ability to reach merit and distinction levels. Therefore setting the bar high at the beginning will boost their confidence. They will need to demonstrate their ability to problem solve, analyse and evaluate the issues and make recommendations which they can justify. If these skills are integrated into every lesson, your learners will be more adept when it comes to applying them in assessments.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 30: Communication Technologies
Introduction In the delivery of this unit, you should maximise the opportunities for links with industry (both large and small to medium-sized enterprises) to provide contextualised examples and scenarios or case studies to reinforce learning. The SOW provides just one way in which you might approach the delivery, although, when planning lessons, you are likely to find overlaps where topics could be delivered in harmony and more holistically. Learning aims A and B integrate to set the foundations for learning aim C. C5 should be the common thread throughout the delivery of this unit and learners should have every opportunity to self-assess, assess and evaluate others and reflect on ways to improve. By reinforcing the importance of these ’soft’ skills, learners will become more employable and blossom, as their confidence grows. One important note: peer assessment is invaluable, but relies on gradual steps to train learners on how to give, receive and act upon feedback.
Learning aim A – Understand data transmission and the technologies used
Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. • This learning aim could be introduced by inviting learners to identify what they already know about communication technologies, as a quick opener to the lesson. The term 'opener' indicates that it relates to the rest of the lesson rather than something just to ‘warm up’. Involving learners in collaborative tasks provides them with opportunities to apply the skills and behaviours, as identified in C5, which they will rely upon to pass their assessments and subsequently progress to higher education and employment. • Undertaking a SWOT analysis is often quite difficult and can even be a little painful, which is why it is suggested as homework to do in private. You could introduce the Johari window later in the course so that learners begin to compare what they believe about themselves with perceptions by others. • Throughout this unit, it will be helpful for learners to have example resources which they can handle and relate to theoretical input. Therefore, signalling methods and transmission media will be accompanied by examples of connections and devices. • The SOW for this unit proposes an expectation that learners should always prepare for the next lesson so that they can make links with their learning and identify gaps in their understanding. This approach develops confidence in you as a tutor by knowing what is coming next and places some responsibility on them to remain engaged. Using online networking to communicate with their peers will help them gel as a cohort. It is also recommended that group/pair activities are structured so that learners get to work with different class members and not to automatically gravitate to work with their friends. This is not representative of business practice and they will learn how to manage conflict and stereotyping. • Note that there a many links to other computing units throughout Unit 30 and several are included in the SOW. Do take opportunities to collaboratively plan with other subject areas, especially engineering, electronics, functional skills and digital media. You may be able to consolidate assignments and team teach.

- There are many magazines, periodicals, manuals and textbooks about technological solutions and data transmission, and learners should be encouraged to really use these resources and not rely on a quick internet search. You might find that by contributing to online sites that you have implemented, such as discussion threads, textwalling and blogging, learners will want to share what they have found useful and explain why this was so.
- Learners should be encouraged to keep an ongoing glossary of technical terms and meanings, not only to ensure that they understand, but so they can provide alternative ways to communicate with others, especially users. The more learners are required to explain something in their own words, the more effective it is for you to assess their comprehension, identify any gaps (to aid your planning) and for learners to practise their communication skills. Encourage learners to contribute to resources, whether digital or otherwise.
- During this learning aim (A2 and A3), it is recommended that you organise a guest speaker and involve your organisation's IT department as they will have some projects on the go or being planned and may welcome sharing or some involvement.
- Encourage learners to relate their learning to any part-time experience they may have, whether it is paid or voluntary. It would be worth encouraging learners to seek out mentors from industry.

Learning aim B – Investigate the implementation of communication technologies

- Learning aim B involves making comparisons between wired and wireless technologies, so the more opportunities learners have to examine samples of components and explore the technology in other environments, the more comprehensive will be their ability to analyse and evaluate their effectiveness. Learners should be able to appreciate that it is only through the knowledge and understanding of these technologies that they will be able to make recommendations and justify their decisions to clients (or users).
- When setting learners direct tasks, such as openers and group activities, expect them to share with the class their key findings and be prepared to respond to questions and feedback. A useful approach to ensure that everyone is involved at some stage is to set a precedent, in the early stages, that everyone must take a turn, so that the process is equitable. It is tempting to avoid the quiet or sensitive ones, but this will do them a disservice by not building their confidence or valuing their opinions and input. There is an opportunity here for an element of mentoring with stronger learners supporting weaker ones on an ongoing basis (not just for this subject area).
- One simple and highly effective approach is for small groups to come up with their own protocols for working, and then compare the top five points with the rest of the class. Surprisingly, they are almost, without fail, the very rules you would want them to abide by, but without you having to tell them. The final agreed five should be displayed in every lesson. Learners will readily point out anyone not abiding by **their** rules.
- During this learning aim, it is suggested that a visit to an employer is organised so that learners can actually talk to and visualise a real-life example. This may be their first ever trip inside a business environment. Learners should prepare some questions in advance to ensure that they can maximise this visit by seeking answers to their questions.
- Another useful visit is a trip to the National Science and Learning Centre at York University where the resources are exceptional. Do not be afraid to ask Blue Chip companies who have readily involved themselves in educational projects, such as

BT (Norwich) and Microsoft (Reading). The local authority is another useful option, and may even put you in touch with the local Employer Business Partnership and other agencies, all of which are involved in technological projects at some stage. They may also know about local schools and colleges undergoing developments. Tutors could also make use of LinkedIn groups (of which there are many) either directly or via their contacts. BCS lists more than 50 stakeholder groups on their website (under the title Specialist Groups) including the BCSWomen group, ICT Ethics Group and a group for Law.

- Another guest speaker and possibly involvement with the IT department should be organised during this learning aim. It would be worth making initial arrangements before you start the delivery. In addition, you will need to plan ahead for any work experience for your learners.
- To pass learning aims A and B, learners will need to be able to explain and compare different methods and technologies. The more opportunities they have to make choices, comparisons and justify their findings, the more adept and skilled they will become. To achieve higher grades, they will need to demonstrate that they can also analyse and evaluate transmission media in preparation for creating a network solution. These words might need defining clearly and one way to put this into their contextual world is to ask them how they make a choice about mobile phone contracts or devices.
- When you are confident that learners fully understand current transmission methods, devices used and systems that make use of communications technologies, you should issue the first assignment that covers learning aims A and B.

Learning aim C – Implement a pervasive technology solution using communication technologies

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- This topic is about designing, implementing and testing a technology solution. While delivery requires tutor input of technical theory, learners will require extensive time to learn how to work as part of a project team along with guidance and formative assessment from their tutor. The SOW suggests a number of techniques and tools that can be used to document every stage of the project and you may know of alternative or additional methods. The more their project can replicate a real-life scenario, the more important it will feel to the learners. No matter how well a simulation is structured and planned, it is not the real thing and can never be. However, if employers or other external partners are involved, the more seriously learners will consider the project. When learners are holding project team meetings in class, it would be ideal to involve external partners who could be interviewed about their requirements, give feedback and make adjustments to the requirements, as would occur in a real project.
- Mock-up examples of projects or component parts are also useful, as the more learners can touch, examine, practise and discuss, the more skilful they will become. There may be example resources which can be adapted or borrowed from other subject areas relating to this topic.
- It is absolutely crucial for the success of your learners that they actively engage in documenting and recording every stage and every single contribution they make, as well as those of the team. Every learner must contribute equally, according to their role, but they will not be able to go back and find evidence unless they take responsibility. Although you can, and should, play a part in writing occasional witness statements of your observations, learners, again, must take responsibility for their actions and be able to anticipate or recognise the consequences and changes that will be made. By involving them in repeating their SWOT analyses,

and perhaps the Johari window, the more they can model their ability to analyse and draw comparisons, then evaluate the outcomes and propose recommendations. They should set themselves targets, which could be in negotiation with you, although these should be driven by them and monitored by you.

- If learners get the opportunity to engage in work experience, they should be involved in planning and preparing, and a debrief should follow. Work experience is most effective when run as a partnership, so it should not be assumed that the employer will find them something to do. A well-structured and informed partnership may subsequently lead to future employment or further work experience opportunities. Tutors should remember that they have an alumni of previous learners who have completed BTEC qualifications and who may be working in industry in a variety of roles.
- The more practical opportunities learners have, the better they will understand what is required for the assessment.
- The assignment to cover learning aim C should be introduced when you are confident that learners are able to design, create and test a pervasive technology solution and produce detailed design documentation. The assessment criteria should be fully explained and learners should be invited to raise questions about any misunderstandings.
- Ideally, the assignment should be based on real examples, and this delivery guide includes several very useful websites that could be used to provide suitable ideas. The IT department or a local employer may be able to provide you with a previous project scenario and the outcomes as a topic for the assignment. Another topic might be about a forthcoming musical event or concert, and perhaps the amateur dramatic society or local theatre could provide some ideas, possibly based on seasonal festivities. A comparison could be made with a local primary school expanding their wireless technology or perhaps a department in the nearest hospital or doctor's surgery.
- Assignment topics and projects should represent the latest in technological solutions and therefore could involve working with apps, QR codes and readers, security systems, 3D printing, robotics and other SMART technology. Topical examples could include aspects of the late 2015 Soyuz launch and connection with the International Space Station.
- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.
- Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 1: Principles of Computer Science*
- *Unit 2:Fundamentals of Computer Systems*
- *Unit 3: Planning and Management of Computing Projects*
- *Unit 4: Software Design and Development Project*
- *Unit 5: Building Computer Systems*
- *Unit 6: IT Systems Security*
- *Unit 7: IT Systems Security and Encryption*
- *Unit 8: Business Applications of Social Media*
- *Unit 9: The impact of Computing*
- *Unit 10: Human–Computer Interaction*
- *Unit 12: Digital Audio*
- *Unit 13: Digital Video*
- *Unit 15: Website Development*
- *Unit 16: Object-oriented Programming*
- *Unit 19: Computer Networking*
- *Unit 20: Managing and Supporting Systems*
- *Unit 21: Virtualisation*
- *Unit 26: Programmable Devices and Controllers*
- *Unit 29: Network Operating systems*
- *Unit 32: Business Processes Modelling Tools*
- *BTEC National IT Unit 1; Information Technology Systems*
- *BTEC National Business Unit 14: Customer Service.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Grant A and Meadows J (eds) – *Communication Technology Update and Fundamentals, 14th edition* (Focal Press, 2014) ISBN 9780415732956
  This book provides information about a wide collection of communication

technologies and their developments over time, with contributions from multiple specialists.

- Russell J and Cohn R (eds) – *Johari Window (*Book on Demand Ltd, 2012) ISBN 5511020125, 9785511020129
  This slimline book describes how the Johari window, created by Joseph Luft and Harry Ingham in 1955, in the United States, is a technique used to help people better understand their mental instability. It is used, primarily, in self-help groups and corporate settings as a heuristic exercise.

Websites

- http://www.bcs.org/category/5815

  This provides a list of specialist groups (some of which have their own linked pages).

- http://www.cisco.com/c/en/us/products/security/customer-case-study.html
  This provides case studies and research.
- http://www.educatornetwork.com
  Microsoft's teacher forum for advice, sharing resources and learning from others globally. It is very useful for learning teaching techniques from other cultures.
- http://ethics.iit.edu/eelibrary/case-study-collection
  This is a database of ethical case studies relating to computing.
- http://www.excellencegateway.org.uk/node/16631
  This is an invaluable free resource for teaching and learning materials based on activities, blended learning and incorporating development of 'soft' and employability skills.
- https://www.gov.uk/government/case-studies/clever-engineering-macrete-bridges-the-technology-gap
  This site provides case studies relating to government technology projects.
- https://www.jisc.ac.uk/content
  This is a direct link to the JISC library containing multiple digital resources on a wide range of technological topics. The JISC community provides teachers with opportunities to network and share ideas.
- https://www.jisc.ac.uk/guides/relationship-management/technologies
  This site gives useful and practical examples of how technology is applied in practice. It has case studies, free resources and copious amounts of information, which are useful for both teachers and learners.
- http://www.legislation.gov.uk/ukpga/1965/4 and http://www.legislation.gov.uk/all?title=information%20technology
  This is a government website with links to technology legislation.
- http://www.local.gov.uk/documents/10180/11553/Transforming+public+services+using+technology+and+digital+approaches/ab9af2bd-9b68-4473-ac17-bbddf2adec05
  This site contains authenticated local government public services case studies.

- http://www.network-box.com/casestudies
  This provides technology project case studies.
- http://www.podbean.com/start-podcast?sourceid=bing_01
  This is one example of a free podcast provider.
- http://www.stemnet.org.uk
  This is a networking site where teachers and employers are brought together to share ideas and create relationships to support learners.
- https://www.stem.org.uk/audience/secondary-computing
  This site gives specialist advice, ideas and practical solutions for teacher computing and technology to secondary and FE learners. It has many free resources and bespoke training events.
- http://www.technologyreview.com/view/526401/laws-and-ethics-cant-keep-pace-with-technology
  The technology review includes issues related to keeping up with laws and ethical considerations in a fast moving industry.
- http://www.textwall.co.uk and http://www.learningapps.co.uk/solutions/textwall
  These are two examples of textwall providers.
- http://www.w3.org
  The World Wide Web Consortium (W3C) is an international community that develops open standards to ensure the long-term growth of the web.

Unit 31: Large-scale Data Systems

Delivery guidance

Approaching the unit

This unit is about 'big data', a subject which is something of a hot topic in computing. Although the hype surrounding it may subside, it is likely to remain important as medium- and large-scale businesses look to extract useful information from the large volume of data they collect. This unit is, of course, related to *Unit 18: Relational Database Development*, but it focuses on the extraction and analysis of data within a database to create information that is useful to a business, rather than the design and development of a database from scratch. If learners are studying both units, then there are some parts, especially in learning aim A, that you may want to deliver together as there is a significant overlap.

As big data is such a popular topic, there are many internet-based resources from major IT companies to support this unit (for example, SAS and IBM) and these can be useful to help learners understand the business perspective of big data.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

Learning aim A is mostly theoretical in content and it can become a little dry if delivered lecture style. Getting the learners to research various topics in small groups and then feeding back to the whole class can help avoid this. There are also a few opportunities for learner to develop their practical skills in using SQL, creating queries, reports etc.

Learning aim B is also mostly theoretical and covers the advantages and disadvantages of big data. To provide sufficient depth of understanding, you will need to investigate specific big data applications and consider their advantages and disadvantages. If possible, try to arrange a visiting speaker who can talk about how their organisation has developed and used big data applications.

Learning aim C has much more practical content, with learners developing their skills in extracting, analysing and presenting information from a large data set. Learners do not need to create the data set themselves: there are a number of real-life data sets on a variety of subjects (for example, sports, financial figures or sales figures) available on the internet.

- You could access data about the football league tables or goals scored in the Premier league for every year from the current one back to 1993 from many Premier league club websites. For example, data for Liverpool FC, can be found at http://www.liverpoolfc.com/match/league/premier-league-2015-2016. This data can be extracted easily into a spreadsheet.

- The Society of Motor Manufacturers and Traders (SMMT) releases data on monthly sales of new cars in the UK. Their website can be found at www.smmt.co.uk/category/news-registration-cars/.
  The data can be downloaded as a spreadsheet.
- The government produces employment statistics by sector: for example the July 2016 statistics can be found at http://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/latest

The data set does not need to be huge, as long as there is sufficient data to analyse and produce meaningful results.

Throughout their practical work, learners should be encouraged to keep a diary in which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital to progressing in higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skills, knowledge and behaviours.

<table>
<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Understand the systems required to process Big Data</td><td>A1 Features of traditional data systems
A2 Features of large-scale data systems
A3 Data mining and data warehousing systems and tools
A4 The challenges of creating systems to handle Big Data
A5 Disadvantages of large-scale data system solutions</td><td rowspan="2">A presentation focusing on traditional data systems, data warehouses and data mining, and the challenges, advantages and disadvantages of large-scale data systems.
A presentation outlining the advantages and disadvantages of large-scale systems to both the general public and commercial organisations, which highlights security of data issues.</td></tr>
<tr><td>B Investigate the advantages and disadvantages of large-scale data systems in organisational operations</td><td>B1 The advantages and disadvantages of large-scale data systems use to the general public
B2 The advantages and disadvantages of large-scale data systems use to commercial organisations
B3 The security of data exchanged between systems, and how personal data is safeguarded</td></tr>
<tr><td>C Analyse a large dataset to meet organisational requirements</td><td>C1 Data selection for analysis
C2 Producing useful information
C3 Evaluating data
C4 Skills, knowledge and behaviours</td><td>A report outlining the problem, the selection of the large dataset, supported by an appropriate subset of data, and the results, including an evaluation of the tools and techniques used in addition to the findings.</td></tr>
</table>

Assessment guidance

This is an internally assessed unit and learners will need to complete internally devised and marked assignments to cover the learning aims.

Learning aims A and B will be assessed together. Each learner could produce a written report covering the criteria, although electronic delivery (such as via a blog, wiki or audio/visual evidence) would be a good alternative to a traditional word-processed document, provided the information is communicated in a clear and detailed manner using appropriate language.

There is quite a lot of material available on big data on the internet, so it would be wise to remind learners about plagiarism. Linking to websites and citing fully referenced quotations is fine, but copying and pasting text directly from an internet source is definitely not.

Learning aim C requires a practical assessment in which learners will need to analyse a data set, present their results and evaluate the outcomes. Learners will need to be provided with a suitable data set to analyse such as those mentioned previously, which can be found on the internet. It is also important that they are provided with a suitable scenario which should include a description of the requirements of an organisation/business for the use of a big data system. If learners have a clear idea of the requirements, it will make it much easier for them to meet the criteria.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 31: Large-scale Data Systems

Introduction

This unit has quite a lot of theoretical content but there are also opportunities to include practical sessions to link the theory to the practice. You will need to look for real-life case studies of big data usage in industry and also procure some data sets for learners to work with.

Learning aim A – Understand the systems required to process Big Data

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- You could help keep learners engaged as you work though the theory content in this learning aim by splitting them into different groups and give each group a different aspect of the topic to investigate. Each group could then feed the results of their investigation back to the whole class who can ask questions and discuss the topic.
- It would be beneficial to include some practical content in this learning aim. Learners can investigate how database queries can be used to extract information from data sets and how reports and charts can be used to present the information. They will need to be provided with simple data sets to work on and instruction on how to use SQL to create various types of queries. This should be limited, however, as this is not a database development unit – it is about how data is used, manipulated and analysed. There are opportunities to investigate free and paid-for software that can be used to analyse data and what the analytical functionality is.
- The Apache Hadoop software is very widely used to implement large-scale data sets across server clusters. If you were able to arrange a visit to a data centre where this (or similar) systems are in use, it would help learners understand the scale and complexity of large-scale data systems. Ideally, you should arrange for the learners to be given a simple demonstration of the system hardware and software and an explanation of how it is used. If this is not possible, a search on YouTube (using 'big data' or 'Apache Hadoop' search terms) will produce a number of useful videos on these subjects.
- There are quite a few open-source data-mining tools which learners can investigate and experiment with (see Resources). While many are quite complex, they do give some ideas as to how data mining can be used and many come with user guides and other documentation so that your more able learners can explore these tools on their own.
- For learners with an interest in maths and, in particular, statistics, there are many advanced data-mining algorithms that they can explore (for example, for regression and clustering).

Learning aim B – Investigate the advantages and disadvantages of large-scale data systems in organisational operations

- It will assist learners to understand the advantages and disadvantages of large-scale data systems if they have some fairly detailed case studies of their application within a variety of different organisations. It would be ideal if you could find someone from a local company that uses a large data system to come and talk to the learners about it. This visit should focus on the business use of the system and its advantages and disadvantages, rather than the technical details of the hardware and software (these will be covered in the visit suggested in learning aim A).

- If a visit is not possible, then two of the biggest software/hardware suppliers in this market, SAS and IBM, have case studies on their websites that you may be able to use or adapt (although there is not much about the disadvantages in these marketing materials).
- There is plenty of opportunity to discuss privacy issues in relation to large-scale data systems. Learners may need to be reminded just how much data about them (for example, where they are at any time, what they spend their money on and what they look at online) is kept. This data is not just kept for commercial purposes: in 2015 the government was planning new laws to compel internet providers to retain data on individual customers' browsing histories. This would be an interesting topic for debate and discussion, as would be the concept of Big Data or Big Brother?
- When you are confident that learners fully understand the challenges, advantages and disadvantages of large-scale data systems for both the general public and commercial organisations and can highlight issues relating to data security, you should issue the first assignment.

Learning aim C – Analyse a large dataset to meet organisational requirements.

Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content.

- In order to prepare them for the live assessment, you could provide a project for learners to work on in small groups so as to practise the skills required for this learning aim. The project should involve creating an outline requirements specification for the system, selecting and importing suitable data into a database, analysing the data to extract useful information and then evaluating the project.
- When covering C1, encourage learners to produce an outline specification for the system that they are developing. This should list the purpose of the analysis and identify the decision-making process that the analysis is intended to support. It is important for learners to understand that the analysis of the large data set is not an end in itself and that the commercial benefit of analysing the data must be clear.
- Ideally, you should provide several different case studies (each with their own data set and business purpose) which different groups can analyse. This will allow the groups to feed their results back to the class. This will encourage discussion, comparison and evaluation of the results, which are the skills that are required to obtain the higher grades in the assessment. Evaluating their own work is something that learners often struggle with, so some practice is valuable. By evaluating each other's work, learners should acquire the necessary critical evaluation skills and they will learn to justify their decisions.
- As part of the analysis of the data, learners could develop a presentation that makes use of charts and other graphical presentation methods to make the information they have extracted from the data clear and easy to understand.
- Although group work on analysing the data is likely to work well, you should also give learners the opportunity to work on analysing data sets on their own in preparation for the live assessment.
- When you are confident that learners fully understand how to analyse a large dataset to meet organisational requirements, you should issue the second assignment. Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 18: Relational Database Development*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in IT. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Marz N and Warren J – *Big Data: Principles and best practices of scalable realtime data systems* (Manning Publications, 2105) ISBN 9781617290343
  This book describes how to build big data systems using an architecture that takes advantage of clustered hardware along with new tools designed specifically to capture and analyse web-scale data.
- Brown M – *Data Mining For Dummies* (John Wiley & Sons, 2014) ISBN 9781118893173
  This book gives a step-by-step guide through a real-world data-mining project using open-source tools to get immediate hands-on experience working with large amounts of data.
- Davenport T – *Big Data at Work* (Harvard Business Review Press, 2014) ISBN 9781422168165
  This book explains, in clear, conversational language, what big data means and why everyone in business needs to know about it.
- Finlay S – *Predictive Analytics, Data Mining and Big Data* (Palgrave Macmillan, 2014) ISBN 9781137379276
  This is an easy-to-read, in-depth guide that offers a solid understanding of predictive analytics, and how they should be applied to improve business decision making and operational efficiency.

Websites

- www.sas.com/en_gb/home.html
  This SAS website has links to case studies of big data implementations.
- www.ibm.com/big-data/uk/en/big-data-and-analytics/case-studies.html IBM
  This IBM website has big data case studies, videos and reports.
- www.oracle.com/technetwork/database/bi-datawarehousing/overview/index.html
  This is the Oracle technology network. The site covers data warehousing and big data resources.
- http://thenewstack.io/six-of-the-best-open-source-data-mining-tools
  This is a list of popular open-source data-mining tools on 'the new stack' technology blog.

Unit 32: Business Process Modelling Tools

Delivery guidance

Approaching the unit

This unit covers the way businesses work and, as such, has little technical content. However, it is closely related to the topic of software development and systems analysis. It also contains quite a lot of business-related content which learners might find challenging. The use of visiting speakers and case studies (preferably of real-life businesses) will be useful to help learners understand the complexity of a modern business. Learners might be surprised at the lack of computing content in this unit (although there are links to subject content provided by the IT industry), but it will be worth reminding them that the skill of understanding the link between the processes used in business and how computing and IT can improve them is highly prized.

This delivery guide does not cover everything that needs to be delivered for completion of this unit but gives examples of delivery methods. You should refer to the specification for full details of all the content that needs to be covered.

Delivering the learning aims

Learning aim A is about understanding the structure of a business and the various processes that make the business work. This may well be an area that learners have limited experience of so it would be valuable to gain some outside input into the delivery of this learning aim, although it can be hard to find external speakers or to arrange visits. Because of the strong business content in this unit, your Business Studies department colleagues may be able to provide some support in this area. The learners themselves may have part-time jobs or contacts through colleagues, friends and family that may be able to help you. Remember that learners need to investigate business processes and these do not necessarily have to be computerised (in fact, it might provide greater scope in relation to this unit if they were not computerised).

Learning aim B is about analysing and modelling business processes. To deliver this learning aim, you will need to prepare some descriptions of business processes, in reasonable contextual detail, on which the learners can practise their modelling skills. These can be real or contrived, but real ones are preferable. If you can get external employers to describe some of their business processes this would be ideal. If not, you will need to look elsewhere. Possibilities include the personal experiences of learners, business processes within your centre or common processes that learners may have experienced (for example, applying for a passport or bank account or booking a holiday).

It is important to provide plenty of opportunities to practise and discuss the analysis of business processes. Drawing various types of modelling diagram will help learners develop the required skills and prepare for the live assessment.

Learning aim C is about developing a plan to improve business processes. As with learning aim B, you will need examples of business processes so that learners can practise their skills of identifying and planning possible improvements. It is likely that you will be able to use some of the business processes from learning aim B. This would be useful, as, having modelled them, learners should have a good understanding of the processes, and they may have already identified some possible areas for improvement.

Throughout their practical work, learners should be encouraged to keep a diary in, which they can keep a record of their progress, any issues they encountered and how they overcame them. This will be valuable when writing the evaluation and reflecting on their own performance as part of the second assignment.

High-quality, accurate communication skills in written and verbal forms are vital to progressing in higher education and in employment. As such, learners should be confident in presenting thoughts and ideas to others, as well as producing well-presented, accurate and appropriate documentation for all stages of a project. Learners must be able to effectively evaluate the success of a project and the factors that contributed to the final outcomes, including their own skills, knowledge and behaviours.

Learning aim	Key content areas	Recommended assessment approach
A Investigate the processes that organisations use to support their activities	**A1** Business aims and objectives **A2** Organisational models and department functions **A3** Types of business processes **A4** Drivers for change	Report, blog or presentation materials covering business aims and objectives, organisational models, department functions and reasons for change.
B Examine an organisation's business processes and activities to inform improvements	**B1** Investigation methods **B2** Analysis of a business process **B3** Business process modelling tools	Interview recordings, observation statements and documentation providing evidence of the investigations. Annotated diagrams of business processes. Records of discussions covering the analysis of the impact of business process changes. Annotated diagram of the improved business processes. Evidence of feedback (recording of discussions or written feedback). Recorded or written evaluations of the plan and the working practices.
C Develop a plan to improve an organisation's business processes and activities	**C1** Sources of innovation to improve business processes **C2** Business process redesign and improvement **C3** Change management **C4** Skills, knowledge and behaviours	

Assessment guidance

This is an internally assessed unit and learners will need to complete internally devised and marked assignments to cover the learning aims.

For learning aim A, learners are likely to produce a written report covering the criteria, although electronic delivery (such as via a blog, wiki or audio/visual evidence) would be a good alternative to a traditional word-processed document provided the information is communicated in a clear and detailed manner using appropriate language.

There is quite a lot of material available on business structure and departments on the internet, so it would be wise to remind learners about plagiarism. Linking to websites and citing fully referenced quotations is acceptable, but copying and pasting text directly from an internet source is definitely not.

Learning aims B and C will be assessed together. Learners will need a case study business, either real or imaginary, which they can investigate and for which they can model business processes. Learners could use the same case study to plan how to improve the processes. The case study should have sufficient detail and the right level of complexity to enable learners to meet the assessment criteria fully without becoming confused unnecessarily by the business-related concepts. It may be possible to use a real-life case study for the assessment but, if this is not possible, then an alternative would be for you to develop an imaginary case study, perhaps based on some aspects of the real-life businesses that you have investigated during your teaching of the unit. This will give you much more control over the case study and allow you to provide sufficient opportunities for the learners to demonstrate their skills effectively.

Getting started

This gives you a starting place for one way of delivering the unit, based around the suggested assignments and tasks in the specification.

Unit 32: Business Process Modelling Tools
Introduction There is quite a lot of theoretical content in this unit. Rather than delivering it by means of lectures, try to make it more engaging by using a variety of delivery methods, including research projects, real-life examples, visiting speakers or visits. Providing lots of opportunities for learners to develop their skills in analysing business processes and identifying opportunities for potential improvement, will be key to helping learners prepare for the live assessment
Learning aim A – Investigate the processes that organisations use to support their activities
Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● There is some basic business content in this learning aim about organisational types, sectors and departments, which could be a little dry if delivered through traditional lectures. An alternative would be to get small groups to research a department or type of business or sector and then report back to the whole class. Encourage learners to consider not only what a department does, but also what information it needs, what other departments in needs to liaise with, and what external bodies it needs to interact with. Learners could, for example, explore their own centre – most of the functions of businesses will be present in this organisation (such as marketing and finance). Learners could also create a questionnaire and ask family members about the departments and functions of the businesses they work for. ● Ideally, you need to include as much real-life information in this learning aim. Many learners will have little experience of working within a business, but some may have part-time jobs and so could share their experience with the group. You may also be able to persuade ex-students to return and talk about their experience of working within a business, the processes that have to be followed and the different departments they have to deal with. ● It would be useful to arrange for a visiting speaker. They do not need to be an IT professional, and it is probably better if they are not. A manager (such as an operations manager) or marketing professional from a local business of a reasonable size would be ideal. Ask them to talk to learners about how their company is organised and how the different departments interact. If they were able to explain something about how the business has changed and developed recently that would also be useful. ● When you are confident that learners fully understand the processes that organisations use to support their activities, you should issue the first assignment.
Learning aim B – Examine an organisation's business processes and activities to inform improvements
Learners should be equipped with a range of skills and knowledge before starting the assignment – do not use the assignment as a vehicle to teach the content. ● In order to develop the skills required to examine a business process, learners really need examples of business processes to practise on. These could be contrived

ones but it would be more realistic to use real business processes. There are several possible sources of information about business processes (see Resources section) where you could find suitable examples. It would also be worth talking to your colleagues in the Business Studies department to see if they have materials that you could use. There is also an opportunity to connect with some of the larger organisations that have educational links (such as Virgin, many financial institutions and retailers like the Co-Operative) – it would clearly be of benefit to approach larger organisations simply because there are more opportunities in terms of areas to investigate.

- To provide learners with an example of a business process, you could attempt to find someone from a business who is willing to explain a process that is used within their organisation. The process needs to be complex enough for learners to be able to model it but not so complex that it is difficult to explain. If this person is willing to be interviewed by your learners either in person, or via video conferencing, then learners can investigate the process and collect sufficient information about it to enable them to model it.
- Another alternative to finding a business process for learners to model is to arrange an industry visit, so that learners can observe the process in action. If this is not possible, you could make an individual visit to collect information about the process and then you could disseminate it to your learners, perhaps by holding a series of mock interviews. Do not forget that your centre is a business too; it may be possible for your learners to investigate a process there (for example, student enrolment). One benefit of this is that the learners will have some personal experience of this process.
- Once learners have sufficient information about the business process, they can practise the use of the various analysis methods listed in the unit content (flow diagrams, decision tables, use case diagrams etc.). Working in groups, initially, will help learners gain confidence but they must also ensure that they are able to complete the modelling and analysis of the process individually in preparation for the assessment. In many cases, there will not be only one right answer to the modelling and analysis so there should be opportunities for learners to discuss alternatives and potential improvements to their models.

Learning aim C – Develop a plan to improve an organisation's business processes and activities

- As with learning aims A and B, the delivery of this learning aim would be enhanced if you are able to get outside involvement from either a local business or your centre's Business Studies department. It would be ideal if you could get a local business manager or owner to come in to talk about how to plan for and manage change.
- You will need a number of business process case studies to enable learners to practise their skills at planning the re-engineering of those processes. You could reuse the case studies that learners used to analyse a business process in learning aim B, but you may need some new and different case studies as well. One possibility is to look at how technological developments (such as increasing use of mobile technology, web-based delivery of services, increasing automation and robotics) will have an impact on traditional business processes.
- In order to meet the assessment criteria for this learning aim, learners will need to understand how to obtain feedback on their plans and how to refine their plans based on that feedback. Learners could, of course, give feedback to each other, but you could also invite Business Studies lecturers or learners to review the plans and give feedback.
- When you are confident that learners fully understand how to develop a plan to improve an organisation's business processes and activities, you should issue the

second assignment. Ensure that learners understand how to fulfil the assessment criteria for the pass, merit and distinction grades.

- It will benefit learners if they maintain a diary or take notes as they complete the various practical activities in the lessons relating to this learning aim. They should also note the comments that their peers make when they give feedback.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Nationals in Computing (NQF):

- *Unit 3 – Planning and management of Computer Projects*
- *Unit 4 – Software design and development project*
- *Unit 9 – The Impact of Computing*
- *Unit 22 – Systems Analysis and Design*.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Computing. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

Textbooks

- Johnston G – *Business Process Re-engineering*, *Kindle Edition*
  ASIN B0076WBWI4
  This is a practical 'how-to' guide based on direct experience of helping businesses to improve their business performance. It is aimed at people who need to make operational and on-time delivery improvements happen.
- Worthington I and Britton C –*The Business Environment*, *Seventh Edition* (Pearson, 2104) ISBN 9780273756729
  This is a comprehensive, but accessible, introduction to the wide range of external influences that affect business operations and decisions in today's increasingly globalised world.
- Ould M – *Business Process Management: A Rigorous Approach*, (British Computer Society, 2005) ISBN 9781902505602
  This is helpful for improving or designing business processes or organisational structures to identify IT solutions, especially those involving BPM systems, workflow or document management.

Websites

- www.gov.uk/government/policies/business-enterprise
  This Government website has some case studies on businesses that have innovated and grown.
- www.gov.uk/government/organisations/innovate-uk
  This is the Government website of Innovate UK. It also has case studies on business innovation.