Unit 23: Emerging Trends and Technologies

Delivery guidance

Approaching the unit

The digital technologies that we use are constantly developing. The increase in the available processing power in everyday computer systems and the increase availability of networks including cloud computing, have led to more and more people utilising digital technologies a part of their everyday life.

The focus of this unit should be to give learners and appreciation of how technologies are developing and refining. From brand new 'cutting edge' technology to increased use and availability of, more established technologies such as cloud computing, learners should explore how these developments in these technologies impact on individuals, organisations and larger society. Following the theoretical input for Learning Aim A, the focus of the learning n this units should be on the use of cloud computing to meet identified needs. This unit does not require use of any specific cloud platform, and centres should explore which platforms would be best suited to the needs of the centre and the learners. Some cloud providers, such as Google Cloud Platform and Amazon Web Services, offer a range of learning materials and even provide free tier access to systems for learners. It is highly recommended that you explore these platforms and others, to identify which system would be best suited to your delivery.

Learners should be encouraged to experiment and prototype, using the could platforms and explore a range of problems and solutions, lessons should try to provide some time to allow for this in addition to specific directed tasks.

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 you could start with a class discussion to explore learners' understanding of current trends in technology. This is potentially a very wide, and ever-changing topic area and the specification provides some content area to help focus learners research and areas for discussion. However, it is suggested that you initially engage learners with a more open and wider ranging discussion in order to pique their interest. These discussions can also lead to discovery of new technologies that were not prevalent at the time of writing the unit. One of the key messages for this learning aim is the constant change and development that occurs in digital technologies, and the importance of keeping up to date with these changes. After initial engagement, use the listed topic areas to focus learner activities. Again, while these provide a starting point and a focus, you will find that the topic areas provide a broader area that can be dived in to more deeply, and allow learners to explore how technology, and application of that technology is developing.

Delivery of this learning aim would benefit from the use of high quality, detailed case studies as well as talks and presentations from professionals in industry. You should provide learners with opportunities to explore a wide range of different technologies in a range of contexts. Encourage learners to explore and discuss a wide range of issues and examples, news articles and professional journals can be very helpful in identifying some of the latest developments.

Learning aim B focuses on the design of a cloud-based solution to meet identified needs. One of the key skills here is the learners' ability to break a problem down in to its component parts (decomposition) and identify ways in which these problems can be solved. Depending on which units have been studied by the learner previously, some time will need to be spent considering how digital solutions can be communicated including defining functional and non-functional requirements and algorithmic design and representation.

Understanding how cloud platforms work and the scope and limitations of cloud technologies is vital to success in this learning aim. As such, following some general theoretical input on some of the aspects of this learning aim (e.g. technical vocabulary, challenges and opportunities of cloud technology), learners may find the content more accessible if it is delivered alongside practical skills that would be required as part of learning aim C.

Learning aim C focuses on the development of a cloud-based solutions. This learning aim should be very practical in its nature. You could start with a look at some small, isolated problems/tasks (e.g. deploying a single virtual machine) and slowly move more complex, multi-faceted problems such as full Private Cloud solutions. You will need to spend some time providing input on general network infrastructure principles (e.g. addressing, routing tables, access management) and drawing parallels with how these are implemented in a cloud-based solution. You should start with highly structured tasks that provide step by step guidance on how to build cloud solutions for specific use cases, and slowly progress to more open problems, that learners must devise solutions for. Providing prompts in terms of types of problems or user needs would also be helpful starting points but learners should be given some time and space to explore creative ways to meet these needs. Learners should be encouraged to experiment and refine ideas over time. Provide some input on how to use analytic and monitoring tools provided by the chosen cloud provider, and provide opportunities for learners to apply iterative development processes to their cloud solutions.

Learning aims B and C are closely linked. While some parts will be taught separately initially, learners should be provided with practical activities that utilise learning from both learning aims. Learners should draw on computational thinking skills that they may have developed in other units and apply them to these learning aims. Also being aware that there are strong links between the practical skills and the development of a solution will greatly help the learners; in order to be able to design an effective solution they must have a strong understanding of what the practical possibilities are.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Investigate developments in computing	**A1** Developments in computing technologies A2 Developments in human computer interaction	A written report exploring the developments in computing and their impact on different industries and society.
B Design a cloud computing solution to meet identified requirements	**B1** Planning a cloud computing solution	A portfolio of evidence detailing the development, testing and monitoring of a cloud-based solution, which may include: • planning documentation for the solution • record of feedback received about plans and actions taken • completed solution • testing and monitoring documentation • user feedback • analysis of feedback and evidence of refinement of solution • evaluation of the development, testing and refinement process.
C Deploy a cloud computing solution to meet identified requirements	**C1** Development of a cloud-based solution **C2** Monitoring and reviewing cloud-based solutions	

Assessment guidance

This unit is internally assessed. There is a maximum number of 2 summative assignments for this unit. Tutors should refer to the assessment guidance in the specification for specific detail, particularly in relation to the requirements for Pass, Merit and Distinction grades.

The first assignment requires to evaluate the impact that developments in computing have had on different industries and society as a whole. They will need to consider the developments both in technology and in ways that these developments impact on the users and how they interact with different technologies. Learners could produce the evidence for this in different ways in including a written formal report or a presentation to the group. If a presentation is used then 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. Reference to specific examples from needs articles, or similar, would be helpful for learners to support specific points.

The second assignment requires the learner to create a cloud-based solution to meet a set of identified requirements. Learners will be expected to define a set of objectives for the solution including functional requirements and success criteria. Learners will need to produce a set of design documentation which will cover the key requirements of the users, plans for the logical network design and cloud (e.g. data, deployment stack, APIs) as well as considering potential risks and how these will be mitigated. Learners should then develop and test their proposed solution ensuring that it is continually tested and refined using appropriate tools provided by the cloud platform, and appropriate functional testing and test users. Finally, learners will be required to evaluate the extent to which their solution meets the identified objectives.

Getting started

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

Introduction

Introduce this unit by discussing with learners their understanding of current trends in technology. Many young people, especially those on an IT course may have a particular interest in this area and have some unique insights to new technologies. This is a great opportunity to engage with learners and draw upon a range of experiences to enthuse learners and explore a range of exciting areas. Where learners may require more direction is technologies relating to less familiar areas of society and organisations, but starting with familiar concepts should allow you to make links to less familiar areas.

It is a good starting point for learners to understand that some developments and trends happen rapidly and some more slowly. For example, cloud technologies have been around for many years, but adoption in some areas has been quite slow until recently where their use has increased more rapidly. Exploring the reasons for these why trends and developments in technologies might vary can provide a springboard for stimulating discussions and detailed research.

Learning aim A: Investigate developments in computing

- Learning aim A should give learners an understating current and emerging trends and technologies, how they are used, and the impact they have on different industries and society. Learner should consider a range of technologies and explore ways in which we interact with technology has developed as technology has changed. Encourage learners to 'evaluate' that is to consider both the positive and negative impacts of developments in order to reach justified conclusions as to the impact that they have had.
- For A1 it may help to start with high profile or well-known developments in technology and move to more cutting edge and less well-known examples as learners get more comfortable with the subject matter.
- Where possible provide links to practical tasks. For example, looking at the developments in cloud computing provides opportunities to start to explore the practical skills that will be used in learning aims B and C.
- Some of the content can often feel quite theoretical in nature but many areas could still provide opportunities for learners to engage in a more practical way. For example, where time and resources allow, providing

learners with access to systems that they can interact with will greatly help develop their understanding.

- You may wish to initially provide some tutor-led input regarding some of the more complex concepts (e.g. blockchain, quantum computing) before the learners start researching and exploring further.
- For A2 need to look at how users interact with systems and how these systems, and methods of interaction, impact on individuals and society.
- As with topic A1 providing practical examples that the learners can interact with is the most engaging. using physical examples. The hands-on nature of using systems is recommended and can provide a meaningful and engaging experience for the learner, allowing them to draw on experience in order to consider how these technologies might impact on others.
- This learning aim also provides good opportunities for educational visits, as well as talks form guest speakers. Particularly with some more advanced or truly cutting-edge technology, it can be difficult for learners to truly comprehend from just a theoretical nature, so providing access to experience it to some degree through a visit can make the learning experience more meaningful.

Learning aim B: Design a cloud computing solution to meet identified requirements

- Learning aim B should provide learners with opportunities to explore computational thinking techniques to design a solution to an identified problem.
- Depending on which units learners have done before this, it may be helpful to draw upon knowledge, skills and understanding develop in other units. For example, learners could draw upon knowledge from unit 2 and unit 10 when considering the data requirements for a solution, or units 21 and Units 23 for example may have provided learners with an introduction to some aspects of cloud computing tools and resources.
- Spend some time with learners exploring how a problem can be broken down into smaller tasks to make the easier to solve, and how in turn the identification of the smaller tasks can lead to clear definition of the functional and non-functional requirements of the system. Again, there is an opportunity here to draw on other units in terms of process, allowing you to focus on the input relating to the specific nature of cloud-based solutions.
- After some tutor-led input into conventions of documentation and solution design (where appropriate), you could provide learners with opportunities to apply these skills to explain solutions. Initially it can be helpful to separate

the identification of the requirements from the final solution design. You could provide the learners with already decomposed problems, and a defined set of requirements, from which they can design potential solutions. Once they are comfortable individual stages of the design process then provide them with opportunities to practice designing a complete solution.

- It could be helpful to learners to see the links between the skills of building a solution and those of designing a solution. Also having a clear understating of what is possible, makes the design process easier. Therefore, it is recommended that the design (Learning Aim B) and practical development skills (Learning Aim C) are taught side by side.
- The quality and clarity of design documents is very important to ensuring a final solution is appropriate. Provide learners with examples of good and not so good design documents that they can analyse. You could also provide learners with a completed system that they have to 'reverse engineer'. In these types of activities, the learner must use a completed system to produce what they think the design documents might have looked like. Reverse engineering tasks can help learners more clearly see the link between design and final product.
- Throughout your teaching you should attempt to link this learning aim with Learning Aim C. Once learners have sufficient practical skills, you could provide opportunities for them to create systems from prewritten design documentation. Varying the quality of the documents you present them allows learners to see issues that can arise if design documentation is not of sufficient quality.

Learning aim C: Deploy a cloud computing solution to meet identified needs

- Much of the learning for this learning aim should be in the form of practical tasks. Provide opportunities for learners to spend time building cloud-based solutions.
- Ensure that you explore the cloud platform that you intend to use with learners thoroughly before starting the practical skills with learners. Make sure you allow yourself plenty of time to evaluate the cloud platforms and choose the one that best suits the neds of your centre and learners.
- Many cloud platforms provide educational and training resources that provide information on how to use their systems. While most platforms overall provide the same functionality, these can often be presented in different ways and terminology can vary slightly from platform to platform. Therefore, using their training materials can be invaluable, both as a

classroom aid, and as a source of independent learning for learners. Utilising these will often help in transferring the 'theoretical' knowledge to practical skills in a way that is specific to the chosen cloud platform

- You could start with looking at computing concepts that learner may already be familiar with, for example, basic network concepts, databases etc. and then providing opportunities to explore these in relation to cloud-based technologies. Providing learners with some premade solutions that they can add to or adapt can help leaners start to see the links between other knowledge and helps build the skills in a less overwhelming fashion.
- As learners grow in confidence you can provide less scaffolding and get learner to produce the larger and more independent solutions. Some time will need to be spent introducing use of the cloud platforms and also some associated knowledge such as web deployment and client-server concepts. This can be achieved through a combination of tutor-led practical demonstrations, self-directed online learning and practical challenges
- You could introduce the concept of testing and monitoring by providing learners with example solutions in various stages of completion and with various levels of functionality. Learners could test the solutions against a defined set of requirements and document the results. For solutions that lack functionality, the learners could use their testing to identify issues and then perform the corrective actions which can then be recorded.
- As learners' familiarity with the problems and solutions increases, provide less scaffolded tasks. For example, you could start with providing a clearly set of defined criteria form which the learners can build a system and progress to a general statement of problem that the learner must fully decompose before developing a solution.

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

This unit links to:

- Unit 4: Programming
- Unit 6: Website Development
- Unit 13: Software Testing
- Unit 15: Cloud Storage and Collaboration Tools
- Unit 25: Full Stack Development.

Resources

Articles

On the impact of quantum computing technology on future developments in high-performance scientific computing – Matthais Moller and Cornelis Vuik
https://link.springer.com/article/10.1007/s10676-017-9438-0

Computing Blindfolded: New Developments in Fully Homomorphic Encryption - Vinod Vaikuntanathan
http://people.csail.mit.edu/vinodv/FHE/FHE-focs-survey.pdf

The Growth of m-Learning and the Growth of Mobile Computing: Parallel developments - Jason G. Caudill
https://www.erudit.org/en/journals/irrodl/1900-v1-n1-irrodl05550/1072065ar.pdf

Software-Defined Cloud Computing: A Systematic Review on Latest Trends and Developments – A. A. Abbasi, et al
https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8758941

Websites

https://cloud.google.com/docs/open-tutorials

Google cloud platform tutorials and documentation

https://aws.amazon.com/education/awseducate/

Amazon Web Services – AWS educate. Platform for learners to gain free training materials and cloud-based resources

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