A new approach to the introductory teaching of Computing and IT at the Open University UK

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Abstract

The Open University of the United Kingdom is a distance-teaching university with no entrance requirements; modules are available world wide. This paper presents a novel approach to the teaching of introductory Computing and IT at the University (level 1 / first-year bachelor's degree). The new module covers: digitization; elementary programming; fixed and mobile communication networks; webpage design; the Internet of Things; and socio-technological aspects of ICT (such as the 'information society', gender issues, health care, and the 'digital divide'). The rationale and structure of the course are presented, with an outline of the content and assessment strategy. Major aims of the new module are: to improve skills development; redress the current gender imbalance in the subject area at the Open University; and improve general completion and progression rates. The module also makes widespread use of on-line activities and forums in support of learning and the development of a sense of a 'community at a distance'.

Keywords: *HE pedagogy; computing; ICT; communication networks; programming; information society.*

1. Introduction

The Open University of the United Kingdom is a distance-teaching university with no entrance requirements – which creates challenges in developing C&IT modules as there is a need to cater for a huge range of students (Bissell, 2011). Modules are available worldwide. This paper discusses a new, level 1 course, TM111 Introduction to Computing and Information Technology I, to be first presented by the Science, Technology, Engineering and Mathematics (STEM) Faculty in autumn 2017.

2. Structure and rational of the module

TM111 provides a broad introduction to Computing and Information Technology concepts, principles, and theories, in the continuing tradition of OU teaching in this field (Bissell & Williams, 2008). The module is designed to appeal to a wide audience, especially to women who are under-represented in this sector of UK HE.

There are three blocks of study, guided by an online study calendar and supported by both printed and online materials, online audio-visual resources, and module forums (Kear, 2001, 2010; Kear *et al*, 2016). The module will be followed for most students by the module TM112 *Introduction to Computing and Information Technology II*. A quiz is used before the start of TM111 to help students assess their readiness for study. Major aims of the new module are (i) to improve skills development, particularly in the area of coding and software development, but also as far as general study competences are concerned (Havergal, 2015) ; and (ii) to improve general completion and progression rates.

2.1. Block 1

Block 1 of TM111 provides an introduction to the role of Computing and Information Technology in everyday life. The block begins with an induction and orientation period of two weeks during which students learn basic 'studentship' skills such as: finding their way around the module resources; visiting the online library; learning what is expected of them in terms of engagement and completion of assessments; and what they can expect of the University in terms of support during their studies. The first two weeks also explore the wide-ranging uses of computing and IT systems in contemporary society, keeping safe online, and key milestones in the development of computers. During the Block students explore important computing and IT concepts relating to their everyday life including:

- The processes by which sound and images in the real world are captured stored, and shared with peers and the wider world through social networking sites.

- How data about people, products and services is stored, managed, and used in online databases – for example, by Amazon the online retailer – and how 'big data' datasets are analysed and exploited.
- The importance of good design in human-computer interaction (HCI) and the importance of usability and accessibility.
- The basic construction of webpages, including CSS and HTML5.
- The historical development of computers (Figure 1).

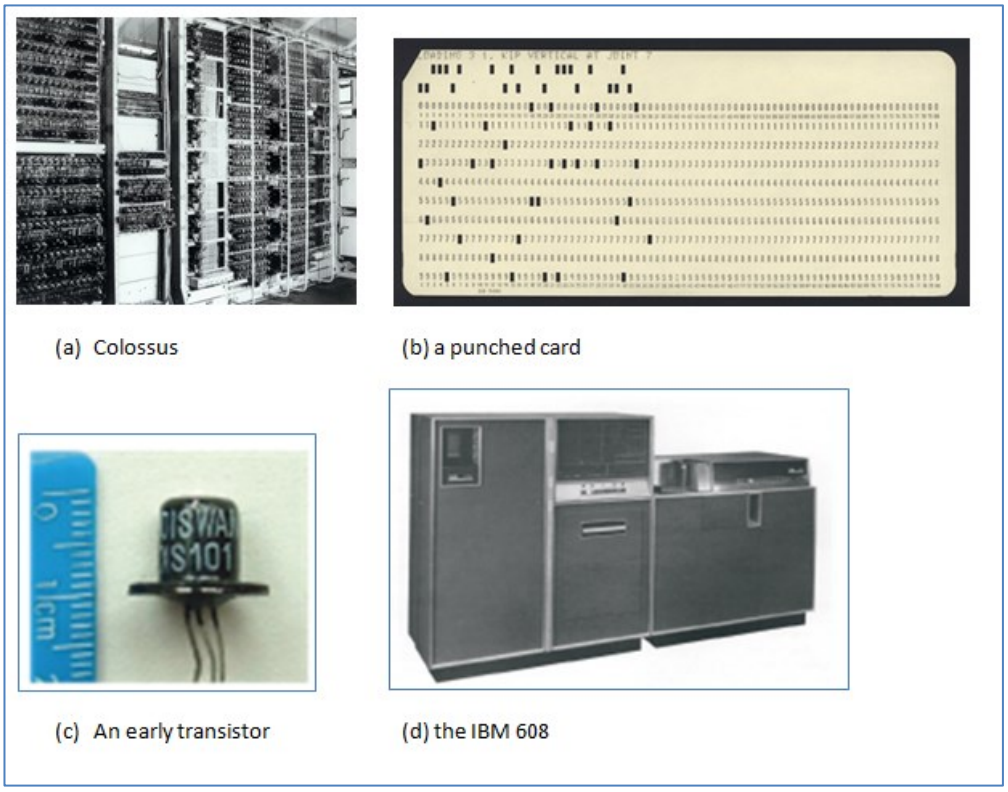


Figure 1. Examples of the historical development of computing

Other important communication and study skills (still inadequate in much of HE), such as note-making and good academic practice, are introduced and taught in context during this block, along with information literacy such as search skills and library skills. Numeracy – working with number bases, for example, SI prefixes, and exponentials – is also taught.

2.2. Block 2

Block 2 focuses on implementing solutions to simple problems in a visual programming environment and the development of elementary algorithmic thinking. Students are introduced to the *Scratch* programming environment (Otts, undated), customized for OU students, and they explore a variety of programming techniques, such as sequencing, iteration and selection. They are encouraged to be creative in producing their own 'sprites' and backgrounds within the environment to develop simple animations and simulations. The activities highlight fun and enjoyment in programming, whilst developing the necessary skills and knowledge necessary for level 1 university study, in the context of employability (something highlighted throughout the module).

Scratch was chosen as a simple graphical approach to elementary programming skills, in order to avoid the problems beginning students have demonstrated in the past with more conventional languages, particularly with pseudocode or similar. (Note, however, that the follow-up module, TM112, will use *Python* (Keopke, 2010), to broaden and deepen students' understanding of coding and software development.) There is an ongoing debate about the 'best' way to teach programming. TM111 opts for the visual way in order to provide a 'gentle' introduction to programming skills for our extremely diverse student cohort. This also helps to raise students' awareness of the strengths and weaknesses of different types of programming, addresses an all too common lack of engagement with programming at level 1 which means that a significant number currently students struggle at level 2.

Figure 2 shows one of the earliest TM111 activities in *Scratch*, causing a sprite to open and close its eyes, while Figure 3 is an elementary numerical programming example.

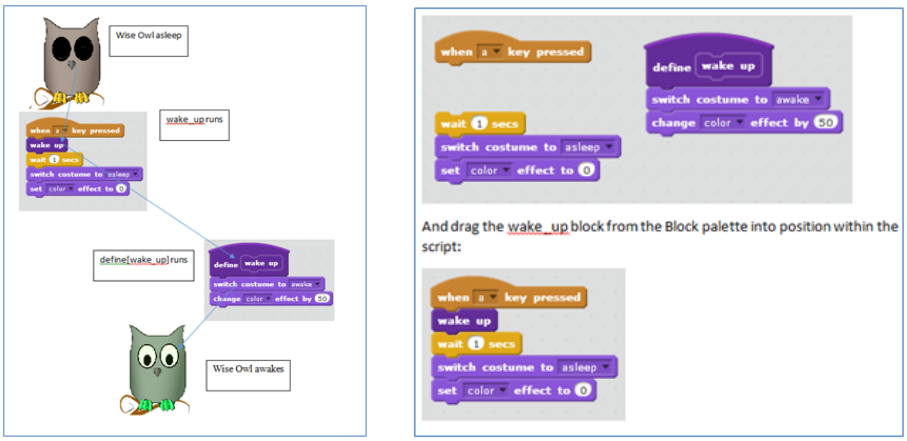


Figure 2. Programming a sprite by dragging function blocks into place; the owl sprite is part of the standard Scratch *specification, and will be modified for adult learners.*

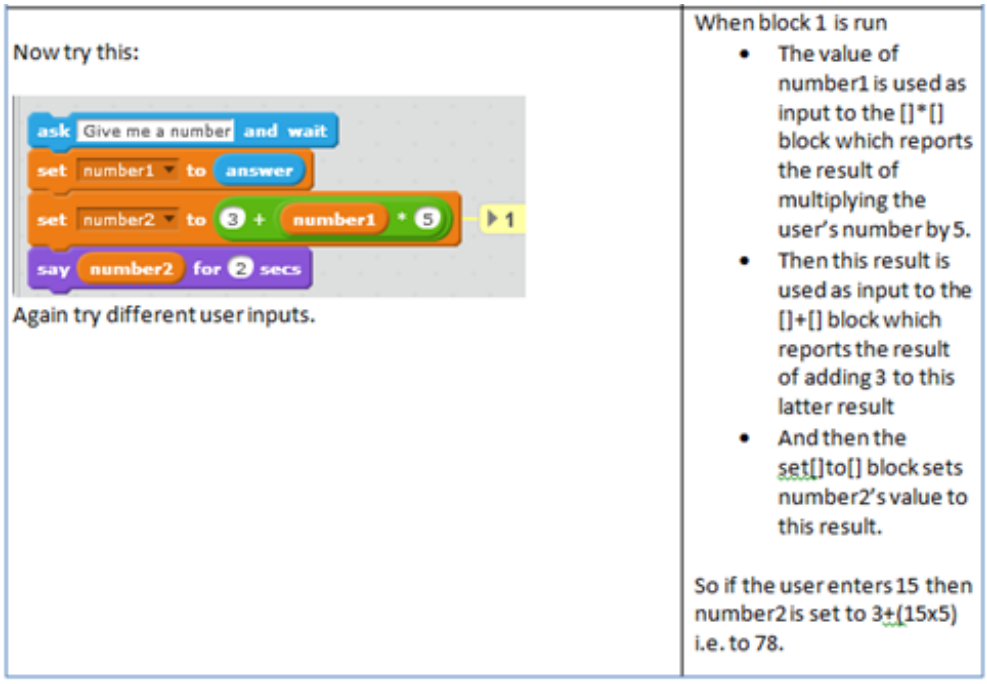
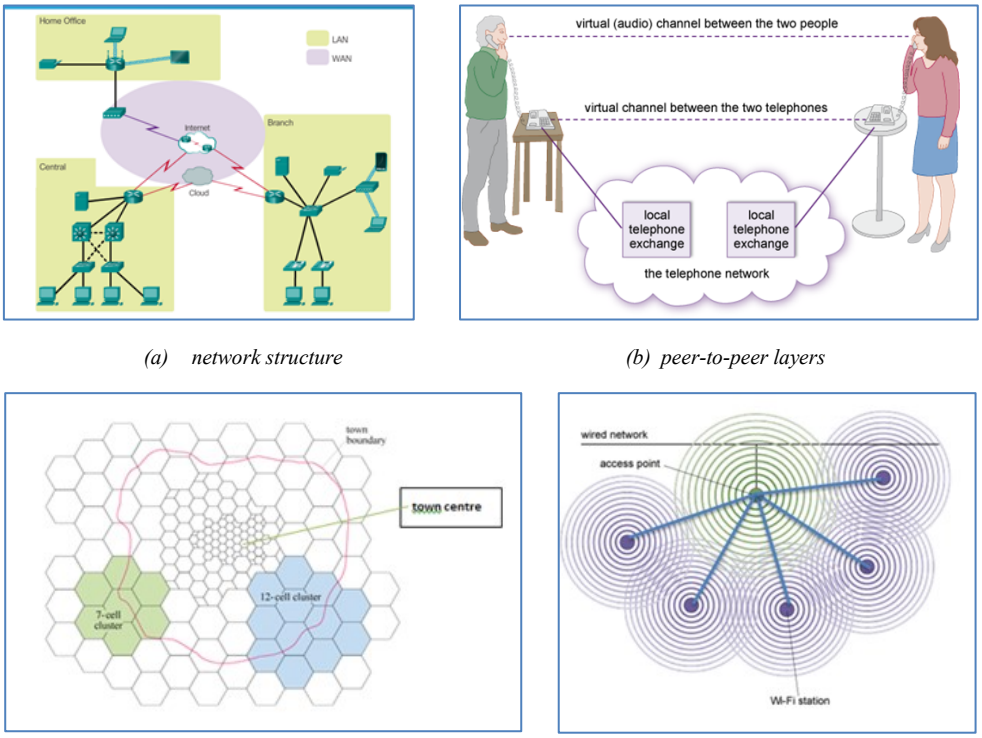


Figure 3. A numerical programming example in Scratch

2.3. Block 3

This final Block deals with communications networks and introduces students to key concepts and technologies underpinning them. The first three Parts of the block explore transmission media, the electromagnetic spectrum, the structure and operation of the internet, and introduces wireless communication. Students gain an understanding of different types of wireless communication including mobile telephony, WiFi, Bluetooth, ZigBee and RFID.

Figure 4 indicates the scope of these first three Parts of the Block. Part (a) shows how LANs and WANs are linked; part (b) illustrates the notion of layering; part (c) is a classic cell topology; and part (d) a typical WiFi infrastructure network.



(a) network structure *(b) peer-to-peer layers*

(b) a cellular system *(d) a WiFi network*

Figure 4. Examples of communication systems covered in Block 3

The final three parts discuss the Internet of Things (IoT), on-line communication, and issues of security, gender, health care, democracy, and 'north/south divides' in ICT (Graham, 2011).

The material on IoT covers topics such as home automation (including coping with signal obstructions), energy harvesting, low-power WANs, and the future of the IoT. The *Online Communication* Part looks at a wide range of asynchronous and synchronous activities, such as forums, group communications, online communities, the social web (*Flickr*, *YouTube*, *Pinterest*, etc), and wikis. A subsection is devoted to social networking products, with a description of their emergence, and a consideration of the similarities and differences between *Facebook*, *LinkedIn*, and *Twitter*. The important issues (positive and negative) of social networking are discussed, as are technological and ergonomic aspects and the notions of social presence and awareness. The final Part of the Block, *The networked Society*, addresses Government and the State, biometrics, DNA information, and networking for health. Three audio interviews are included with researchers who have investigated: the impact of mobile phone use on the lives of socially excluded young women; projects

exploiting digital technology to benefit schools in Nepal; and the use of ICTs to for personal health monitoring.

2.4 On-line activities throughout the course

Peer review and group work skills are promoted throughout the module through on-line, forum-based activities, including those run by Associate Lecturers for their individual tutor groups of around 25 students. The in-house environment *OpenStudio* is exploited for online file sharing and other applications (Thomas *et al*, 2016). The module team aims to create a strong sense of a learning community, particularly in Block 2 where there are specific on-line activities to support the teaching of programming and problem-solving.

3. Assessment

A wide range of assessment is employed (Heap *et al*, 2004). Continuous assessment for the module consists of three tutor-marked assignments (TMAs) marked by Associate Lecturers, and three interactive computer-marked assignments, iCMAs. The TMAs provide an opportunity for personalised tutor feedback and assist a student's progression to the following module TM112. The iCMAs consist mainly of short-answer and multiple-choice questions to check knowledge and understanding. The cut-off date for the first iCMA (iCMA01) occurs early in the module, to ensure that students are engaging with the module in the early stages so that advice can be provided. The second and third iCMAs take place midway through blocks 2 and 3 respectively. Assignment iCMA02 will test numeracy, problem-solving and programming, and iCMA03 further tests knowledge of networks and numeracy associated with networks. Students will count their best two iCMA scores towards their final score. TMAs occur at the end of each block of study and assess the content covered in the block. Skills development will be assessed in TMAs – for example, skills in communication in writing will be developed in Block 1 and extended in Block 3.

4. Conclusion

The new UK Open University module TM111 *Introduction to Computing and Information Technology I* adopts a very broad approach to the introduction to the subject area. Learning materials include a coverage of theory, technology, practical skills development, and the wider socio-technological issues in the ICT and computing field. Students have traditionally found many of these concepts – particularly mathematical and programming topics – problematic, so great care has been devoted to the choice of software environment, the mix of methods (from print to animations and computer-aided learning packages) and to the staged development of skills throughout the course. Once completed, the course is

excellent preparation for the more advanced modules offered by the University at higher levels of a bachelor's degree.

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