Concepts of ICT Literacy in Higher Education

Allan Martin
University of Glasgow

1. Introduction

Almost from its first appearance in the 1940s, the computer has been perceived as something whose impact upon the world and its inhabitants will be profound. It rapidly entered popular culture, as both the deliverer of a utopian future, and as a potential threat to humanity. Kurt Vonnegut's *Player Piano* of 1952 presents a not-so-distant US society run as a technocracy with, as its planning heart, the giant computer EPICAC XIV. A revolution eventually overthrows the ruling organisation, and smashes up the computer; but at the end the people cannot resist beginning to tinker with the pieces again. The relationship of man to technology is reformulated for the computer age by Arthur C. Clarke and Stanley Kubrick in *2001: a Space Odyssey*, in which the use of tools by men reaches its apex in the computer, the tool which equals man himself, and then threatens to displace and supersede him, but instead triggers the emergence of a new form of mankind. It should not surprise us that at all stages of education a response was felt to be necessary even at a time when the impact of computers on individuals was small, and the more so when the everydayness of computers has become a reality.

We may look at concepts of computer literacy as passing through three phases, the *Mastery* phase (up to the mid-1980s), the *Application* phase (mid-1980s to late-1990s) and the *Reflective* phase (late-1990s on). The offering of three phases should not suggest an organised and systematic development, rather a gradual change of emphasis, to which not all participants necessarily subscribe.

In the **Mastery** phase the computer is perceived as arcane and powerful, and emphasis is placed on gaining knowledge and skill to master it. "Computer Basics", whatever they are called, consist of how the computer works (simple computer science), and how to program it (using whatever languages were current at the time), with sometimes additional input on the social and economic effects of computers. Late in this phase (1976) the term "computer literacy" is proposed by John Nevison, writing in the magazine *Science* that:

> Because of the widespread use of elementary computing skill, there should be an appropriate term for this skill. It should suggest an acquaintance with the rudiments of computer programming, much as the term literacy connotes a familiarity with the fundamentals of reading and writing, and it should have a precise definition that all can agree on.
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> It is reasonable to suggest that a person who has written a computer program should be called *literate in computing*. This is an extremely elementary definition. Literacy is not fluency. (Nevison, 1976: 401, italics original).

However, the content has not changed, remaining focused on programming. Even later (1978-79) the desktop personal computer (PC) appears; this creates a mass market in computing and offers every individual the possibility of access to computing power. However, the emphasis of computer literacy does not change, because the lack of user-

friendly applications means that the computer remains a specialist tool or hobby vehicle. Nevertheless, the demands of the market lead during the 1980s to the development of simple user interfaces and easy-to-use mass market applications, which stimulate a major rethink of notions of computer literacy.

In the **Application** phase an intuitive graphical user interface is taken for granted, and the computer is perceived as an everyday tool which can be applied to a wide range of activities in education, work, leisure and the home. *Windows* and similar interfaces are the norm. Applications software becomes more powerful and simpler to use. "Information Technology" or "IT" becomes the normal term of reference to computing activities. How to use computer applications becomes the focus of computer literacy activity, and definitions of "computer literacy" or "IT literacy" focus on lists of practical competences rather than (as in the Mastery phase) specialist knowledge. This is reflected in the mountain of training materials produced and the appearance of mass certification schemes focusing on basic levels of C&IT competence. It is also now feasible to build C&IT literacy requirements into curricula at school and post-school levels. The development of the Internet happens during this phase, but change is only stimulated when very simple tools for email and for navigating the world wide web appear in the latter half of the 1990s.

In the **Reflective** phase the facility with C&IT tools is taken for granted, or regarded as something straightforwardly acquired either as early as possible (preferably in childhood) for generic competence, or wherever needed for more specific competence. The emphasis moves towards reflective and evaluative aspects of usage: deciding upon appropriate usage of applications, evaluating the data which they give access to, interpreting the information they generate, and deciding upon appropriate use of the resulting document or product. In this phase the notion of "information literacy" which has been developing in the user education areas of the library since the 1980s converges with changing ideas of C&IT literacy. Terminology is still unsettled, with claims on the one hand that "Information Literacy" now encompasses C&IT, and on the other suggestions that "literacy" should be superseded by a term such as "fluency" connoting a more sophisticated and situationally-relevant approach. The importance of communications technologies is recognised in the increasing use of terms such as "ICT" and "C&IT".

Each phase is fitted to the technological environment of its time – to the extent of access to facilities, and the characteristics of software and hardware – but also to educational and socio-economic assumptions. Echoes of earlier phases persist, so that for instance the argument for mass learning of computer programming can still be heard.

2. Computer Literacy in Higher Education to the 1980s: the Mastery Phase

By the middle of the 1960s the perceived importance of computers for higher education, together with the lack of co-ordination thus far, prompted official action. The Barnard Report of 1970 (UGC/CBURC, 1970), in considering those students to whom computing experience should be made available, offered several forward-looking arguments:

i. Computing is an all-purpose tool. The report quotes an earlier U.S. report asserting that, "Computing is not an esoteric or specialised activity; it is a versatile tool useful in any work with a factual or intellectual content" (quoted in ibid.: 5).
ii. Computers are significant for the whole curriculum: "Computers will usurp the traditional functions of libraries and will be regarded as essential aids to any form of scholarly activity. Thus, we may even expect to find computers in regular use in arts departments as well as in science and engineering." (loc. cit.).
iii. The power of this tool should be available to the élites of tomorrow: "Graduates from *all* disciplines fill leading posts in industry, business, government both local and central, medicine, education and research of all kinds." (loc. cit., emphasis original).
iv. Practical computing skills will be valuable in employment. "The practical experience of computing will help students in their future careers." (ibid.: 6)
v. The application of the computer to subject skills should be "strongly encouraged" at undergraduate level, not only because of the practical benefits, but because it will "add to the value of undergraduate studies" (ibid.: 6).

The recommendation made is emphatic: "We have no hesitation ... in advising that all undergraduates should be taught computing." (ibid,: 5) The main focus of computer skill in Barnard was upon programming (at that time the only way of making the computer do anything), with a small admixture of information about the computer and its impact. Programming skills would enable students of all subjects to make use of the computer. This is consistent with approaches to "computer literacy" throughout the 1960s and 1970s, in schools as well as higher education.

Alas, the target set by Barnard would stretch the credibility as well as the purses of most universities. McDonough, writing of Queen's University, Belfast, suggests some of the reasons that applied to all universities:

> Despite good intentions in this direction, Queen's University, in common with most other universities in the United Kingdom, found it impossible to implement this major recommendation [that all undergraduates should have some experience of computing]. The main reason was lack of finance, though there were other important causes. Mainframe computing was not ideally suited to undergraduate use with its demand for large numbers of simultaneously active terminals. The lack of educational software was a major disincentive in humanities departments in the University. The lack of experience of many members of staff in these departments in using computers was also a major obstacle. (McDonough, 1986: 113)

The 1970s was nevertheless a period of great activity in the use of computers in higher education. The overall picture is that of the computer becoming established as a tool for learning as well as for research, particularly in respect of simulation, data processing, calculation, and graphic display. Development of Computer Assisted Learning (CAL) programs formed a strong developmental strand, with much work carried out through the National Development Programme in Computer Assisted Learning (1972-77) (see Hooper, 1977 for an account of NDPCAL).

The "desktop revolution" at the end of the 1970s soon impacted in the universities. The 1983 Nelson Report (CBURC, 1983) addressed the task of enabling undergraduates to achieve a level of competence in computer skills which they could use within their own subject areas. The chief obstacle was seen as the lack of terminals for students to work

at, and the main recommendation was that more hardware should be seen as a priority. The main effect of the Report was to focus on hardware acquisition and deployment, but universities generally lacked the funds (and the willingness to so deploy them) to achieve the 5-1 ratio proposed. Much energy was expended exploring methods of raising the money and arguing over who should get the computers, a frequent conflict being that between the centralisers, who preferred to see computing facilities organised centrally, under a Computing or IT Service, and devolvers, who saw faculties and departments, where teaching was carried out, as the natural home of computing provision.

It was assumed by many that students would pick up the necessary skills through usage. This theme has always been a thread in the computer literacy debate, the thrust being that students are intelligent well-motivated people who will identify the skills they need and learn them, if necessary persuading other students to help in doing so. In policy terms it allows the weight of action in developing computer use in higher education to focus on the provision and appropriate distribution of computing facilities. It also supported the notion that the main effort in respect of training and awareness-raising should be directed towards university staff, since if academics could be persuaded to incorporate computers into their teaching, students would have to follow. However in a small number of universities, efforts were made within some departments to provide relevant computing skills for students.

3. The Application Phase

With the development towards the end of the 1980s of easy-to-use graphical interfaces and powerful user-friendly generic applications widely available on increasingly powerful desktop computers, we enter the **application** stage of computer literacy development, in which "IT literacy" became focused on practical use of applications such as word processing, spreadsheets and databases. In this stage student C&IT provision becomes a high priority and the issue of student C&IT skills assumes greater and greater importance. Computing/IT Services have often responded to the increased use of generic applications by provision of self-teach leaflets, following a pattern established for the specialist applications used earlier. But as it becomes clear that generic C&IT applications have a major part to play across the whole higher education curriculum (even at the simplest level of word-processing an essay), and that therefore the whole student body, not just well-motivated research students, needs to be able to use C&IT skills, the question of skills provision becomes more urgent. Thus, as the 1990s develop, more HEIs develop major programmes which deliver C&IT skills to large numbers (sometimes as part of more comprehensive key skills programmes), or which require the integration of C&IT skills development into normal subject course tuition.

Some projects in this area were able to gain funding through the Enterprise in Higher Education (EHE) Initiative, set up in 1988 by the Department of Trade and Industry with the aim of getting both the institution and its students to carry out enterprise focused activities, and to develop enterprise-related attitudes. "Enterprise" was defined in broad terms, and often enabled funding to be gained for programmes intended to develop transferable skills extending beyond the academic, including C&IT skills.

Despite the significant steps taken by some institutions, and the activity of enthusiasts in most institutions, the 1991 McDonough Report (IUCC, 1991) suggested that academics in general had little incentive to get involved in IT-based teaching. A new initiative, the Teaching and Learning Technology Programme (TLTP), was launched the same year, with the aim of promoting the use of IT in teaching and learning. Most of the projects funded through TLTP involved the development of CAL or software tools for particular subjects, however one project, at Durham University, looking at IT across the institution, included a focus on student C&IT training needs (Hodgson et al., 1995).

By the mid-1990s HEIs were increasingly recognising that student C&IT literacy was an important objective. Several strands of action are evident in the changing picture:

i. In many universities Computing/IT Services developed self-teach materials focused on particular applications. This activity had been going on for many years, at first focusing on specialist applications for limited numbers of users, then including more generic applications and being directed towards any student.
ii. Meanwhile, individual departments in many institutions continued to develop their own courses on "Basic IT" or "Introduction to the Computer", with an emphasis on the applications required for study within the department.
iii. In a few institutions (e.g. Durham, York, Glasgow) co-ordinated programmes were organised specifically focused on delivery of basic C&IT skills. These usually originated within the Computing Service (as in Durham and York), but could originate elsewhere (as in Glasgow).
iv. In some universities (e.g. Luton) C&IT skills were included in programmes covering a wider range of "key" or "core" skills considered necessary for the student or for the graduate (e.g. Sunderland, Cheltenham and Gloucester CHE, Sheffield Hallam).

4. The Reflective Phase

Of major significance for the approach to C&IT taken by higher education the MacFarlane Report (COSUP, 1992), which despite its Scottish origin and focus was seen throughout the UK as pointing the way forward. MacFarlane insisted that for higher education to move forward, a whole perspective on the nature of the learning environment must be maintained, with more student-focused learning approaches matched by a suffusion of C&IT across curriculum and pedagogy. This would have profound effects upon students:

> Students will have to be taught how to manage their own learning processes to an unprecedented degree. They will have to learn how to swim in a sea of information, to use the rich resources of a supportive learning environment, to self-pace and self-structure their programmes of learning. They will have to choose from a spectrum of learning styles ranging from virtual self-instruction under support to group working of various types. The effectiveness of each individual student's learning process will have to be efficiently monitored, and appropriate arrangements devised for each individual student to interact effectively with supervisors and tutors. The supportive environment will offer the student a powerful and continuous means for self-assessment and for planning the development of their learning processes and skills generation. There will be a continuing need for academic counsellors and tutors, and for collaborative inputs in areas like study skills. (COSUP, 1992: 32)

In considering how this change in practice is to be achieved, the need for training of students in the use of C&IT is acknowledged.

This approach was underlined by the publication in 1993 of the report of the Joint Funding Councils' Libraries Review Group (JFCLRG, 1993), known as the Follett Report, which drew attention to the need to develop substantially the ways in which C&IT could support the functions and use of university libraries, and which libraries themselves could contribute to holistically perceived learning environments.

The key role of C&IT in a holistic and student-centred learning environment was one again underlined by the Dearing Report (NCIHE, 1997), which states that, "The aim of higher education should be to sustain a learning society." (*Summary Report* §23) The "learning society" reflects the notion of a post-industrial society in which knowledge is a key commodity, flexibility is a characteristic of the workforce, and leisure is a characteristic of social life. This has implications for the way in which education is organised and offered: it is organised into identifiable units which can be taken individually or joined together in combinations, and these are offered through a variety of teaching methodologies, including distance and resource-based modes. "New technology is changing the way information is stored and transmitted. This has implications both for the skills which higher education needs to develop in students, and for the way in which it is delivered." (ibid., §20)

A significant element in Dearing is the flagging of "key skills" as part of the higher education agenda for the learning society. All students need to have "key skills": communication, numeracy, use of C&IT, and learning how to learn. "We see these as necessary outcomes of all higher education programmes." (ibid., §38) As higher education becomes a mass-market commodity, an increasing proportion of students may lack some basic skills, and teaching departments will not have surplus capacity to spend "bringing them up to scratch". Each HEI will have to deal with this problem, either by restricting entry to those students who possess all the basic skills, or by setting up structures to provide them.

Dearing has stimulated a movement of the learning environment into a position of more strategic centrality, and this has hastened a number of developments in terms of the C&IT-related facilities made available to students:

i. Follett, and the activities of the eLib projects raised the focus on the "hybrid library", in which access to C&IT-based resources is as important as access to traditional paper-based stock.
ii. Technical developments have enabled serious consideration of virtual learning environments (VLEs) through which students are give access to a range of online resources, tools and interactive facilities specific to themselves, and managed learning environments (MLEs), in which a VLE is located within the institution's administrative data structure.
iii. There is a growing trend for Library and computing or IT services in HEIs to merge into single "information services". Such mergers have however not been easy, because of the tension between different cultures within the merged services.
iv. The result of such mergers may be the creation of integrated learning support centres, where formerly separate computing, library, and other student support facilities are offered.

v. The setting up of co-ordinated key skills programmes has been undertaken by several institutions.

In terms of the evolution of notions of computer literacy, there is an emergence of more holistic and reflective ideas of how students should be inducted into the learning environment. This is evident in two particular developments, the search for more reflective notions of computer literacy, and the concept of information literacy. These concepts underline the convergence of strands of thinking from IT training and from library user education fields.

The term "fluency" is proposed by an influential US National Research Council report (NRC, 1999). The report comments that

> Generally, 'computer literacy' has acquired a 'skills' connotation, implying competency with a few of today's computer applications, such as word processing and e-mail. Literacy is too modest a goal in the presence of rapid change, because it lacks the necessary 'staying power.' As the technology changes by leaps and bounds, existing skills become antiquated and there is no migration path to new skills. A better solution is for the individual to plan to adapt to changes in the technology. (NRC, 1999: 2)

Fluency in Information Technology ("FITness") covers three types of knowledge:

i. *contemporary skills*: "the ability to use particular (and contemporary) hardware or software resources to accomplish information processing tasks." (ibid.: 18) This covers most of the applications-focused student IT training currently being carried out. Naturally these skills will change over time as hardware and software evolve.
ii. *foundational concepts*: "the basic principles and ideas of computers, networks, and information." (ibid.: 2-3) These include computer structure, information systems, networks, modelling, algorithmic thinking and programming, the limitations of IT and its social impact.
iii. *intellectual capabilities*, which "integrate knowledge specific to information technology with problem domains of personal interest to individuals." (ibid.: 20) These are general thinking skills which might be recognisable in many disciplines, and include sustained reasoning, managing complexity, testing solutions, evaluating information, collaboration, anticipating change and expecting the unexpected.

However, it is not clear yet how widely this approach will be adopted. Whilst thinking skills can be seem as a valuable complement to familiarity with applications, the need for an elementary grounding in computer science may be difficult to understand. In the end IT Fluency may be seen as a computer scientists' vision of a reflective IT literacy.

An alternative vision is presented in the notion of "information literacy", which has developed in the US since the late 1980s as a re-focusing of "bibliographic instruction" (the equivalent UK term is "user education") in academic libraries. The refocusing arose from awareness of the same trends in teaching and learning noted by MacFarlane. An influential 1987 symposium recommended that, "Reports on undergraduate education identify the need for more active learning whereby students become self-directed independent learners who are prepared for lifelong learning. To accomplish this, students need to become information literate." (Breivik & Wedgeworth, 1988: 187-188) The notion was soon backed up by the report of an American Library Association committee (reprinted in Breivik, 1998: 121-137), which defined the information literate person as

one who, "must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information." (ibid.: 121-2). A recent report from the Association of College and Research Libraries focuses on higher education (ACRL, 2000), and presents a set of performance indicators based on five "standards":

> The information literate student:
> i. determines the nature and extent of the information needed;
> ii. accesses needed information effectively and efficiently;
> iii. evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system;
> iv. uses information effectively to accomplish a specific purpose;
> v. understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally. (ACRL, 2000: 8-13, passim)

Information literacy has only gained ground recently in UK library circles, although library User Education specialists had been delivering library skills courses to students for some time, and SCONUL has offered the "seven pillars" model, where IT skills and basic library skills support seven "information skills", increasing competence in which ultimately leads to achievement of information literacy (Town, 2000: 16-20)

These developments serve to indicate that debate on the issue of "higher" or reflective C&IT literacy is still ongoing, but a number of conclusions may already be drawn about the "reflective" position:

i. C&IT induction must move beyond the mastery of applications;
ii. It must address a learner-centred pedagogy;
iii. It must extend beyond the computing lab and the library;
iv. It must meet the perceived needs of learners;
v. It must induce thinking.

There is however still some way to go before such ideals can be realised. A survey carried out by UCISA in late 1998 and early 1999 reported that 36% of respondents provided training for students in "Learning and Teaching Technology" (Armitage et al., 1999: 7). This was a notably lower percentage of positive responses than for most other support activities. However, when asked which areas were to receive increasing support in the near future, 33% of respondents indicated that they were moving into the area of student training (ibid.: 10, 27). This was the largest indication of a new area of activity. Awareness of need is the beginning of the search for wisdom.

References

ACRL (2000) *Information Literacy Competency Standards for Higher Education* Chicago Association of College and Research Libraries

Armitage, S., Rothery, A., & Jenkins, M. (1999) *Report of a UCISA survey of support provided in Universities and Colleges for the use of technology in teaching and learning* Oxford Universities and Colleges Information Systems Association – Teaching, Learning and Information Group

Breivik, P.S. & Wedgeworth, R. (ed.) (1988) *Libraries and the Search for Academic Excellence* Metuchen NJ Scarecrow Press

Breivik, P.S. (1998) *Student Learning in the Information Age* Phoenix Oryx Press
CBURC (1983) *Computer Facilities for Teaching in Universities* Computer Board for Universities and Research Councils London HMSO [Nelson Report]
Corrall, S. & Hathaway, H. (ed.) (2000) *Seven Pillars of Wisdom? Good Practice in Information Skills Development* London SCONUL
COSUP (1992) *Teaching and Learning in an Expandiing Higher Education System* Committee of Scottish University Principals [MacFarlane Report]
Hodgson, M., McCartan, A., & Hare, C (1995) *Teaching and Learning in Higher Education: The Integrative Use of IT within the Institutional Context* University of Durham
Hooper, R. (1977) *National Development Programme in Computer Assisted Learning: Final Report of the Director* London Council for Educational Technology
IUCC (1991) *Report of the Working Party on the Provision of Computing Facilities for Teaching* Inter-University Committee on Computing [McDonough Report]
JFCLRG (1993) Report of the Joint Funding Councils' Libraries Review Group HEFCE [Follett Report]
McDonough, W.R. (1986) "The Aeneas Project - implementing the Nelson Report at Queen's University, Belfast" *University Computing* **8**: 113-115
NCIHE (1997) *Higher Education in the Learning Society: Report of the National Committee* National Committee of Inquiry into Higher Education London HMSO [Dearing Report]
Nevison, J.M., (1976) "Computing in the Liberal Arts College" *Science*, Oct. 22, 1976, pp.396-402
NRC (1999) *Being Fluent with Information Technology* Committee on Information Technology Literacy, Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics and Applications, National Research Council Washington DC National Academy Press
Town, S. (2000) *The Seven Pillars Model* Report of the SCONUL working party on Information Literacy London SCONUL
UGC/CBURC (1970) *Teaching Computing in Universities* London HMSO [Barnard report]
Vonnegut, K. (1992) *Player Piano* London Flamingo [first UK edition: Macmillan, 1953]

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