Planning for IT Literacy in an Institution of Higher Education: A Case Study

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Middlesex University has committed itself to develop 'IT literacy' in all its students by 1995, but the achievement of this goal is not without difficulties. In this paper an attempt is made to define IT literacy, which it is argued comprises more than just practical operational competence with basic computer equipment and softwares, but extends into informed attitudes, and is also divisible into the two categories of very basic (generic) skills and the particular skills necessary to be competent within a subject discipline. This raises issues of where IT literacy should be located in a student's work programme in order for it to be most effectively delivered and for it to have maximum relevance to the student. Different approaches tried at Middlesex are described. The paper concludes with a brief review of some of the implementational implications of introducing an IT literacy provision for all students.

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1. INTRODUCTION

Recent years have seen several initiatives, not least those of Enterprise in Higher Education (Department of Employment) and Higher Education for Capability (Royal Society of Arts), designed to bring new ideas to bear on higher education and on the curriculum at this level. Such initiatives are marked by a concern with the quality and range of abilities of the graduate, both in terms of his/her specific area of studies and in broader terms of 'generic' or 'personal skills'. Curricular conversation these days is replete with references to 'enterprise', 'capability', 'competences' and 'outcomes'. Prominent among such skills of the well-rounded graduate is an ability to communicate effectively across the whole range of readily available media—and, in the 1990s, that has to include a basic working familiarity with information technology.

As one of the successful institutions in the first round of Enterprise bidding, Middlesex University (as it now is, although then a Polytechnic) was already aware of such issues and seeking to explore ways of more fully implementing these 'new' ideas into its teaching provision to students. This experience forms the basis of this paper, which will address two themes: first, an exploration of 'IT literacy' and its implementation in a higher education institution (HEI); and, second, an exploration of the issues, challenges and problems thereby raised for the overall IT strategy of the HEI as a whole.

2. WHAT IS 'IT LITERACY'?

The answer to this question is surprisingly hard to unearth even though the term (or its counterpart of 'computer literacy') is relatively frequently encountered. Indeed, the IUCC [5] refers to 'widespread uncertainty' over meaning and admits that, after broad consultation with employers and professional institutions, it could only offer 'a fairly broad definition, namely that being computer literate meant having an awareness of the functions which can be performed by computers and associated hardware and software' (p. 18). As expressed, this can only be described as a fairly passive form of literacy, there being no mention of the computer-literate individual actually putting this awareness to any use; but, in all fairness, this can be assumed to be implied, for the report goes on to refer to the computer literacy programme at Durham University which aims 'to provide the opportunity for all undergraduates, regardless of academic discipline, to acquire the skills necessary to use a computer appropriately and effectively in their work ... (and) ... to provide the means by which all students become confident and competent users of computers'. Even so, we may still be talking here of a relatively restricted package of largely operational computing skills, delivered in discrete learning chunks; valuable, no doubt—but the suspicion remains that full IT literacy may be more than just this.

Part of the difficulty of defining IT/computer literacy seems to lie in the fact that, although there may be broad agreement on certain key ingredients, there is also scope for a range of interpretations reflecting the particular viewpoint of the interpreter. So, for example, although it would probably be true today in most instances that the terms 'IT literate' and 'computer literate' would be largely interchangeable, there is always the risk that they are not—that the latter is more limited in its scope to computer operational skills, to the detriment of the wider concern with the nature and uses of information and of communication (notably electronic and computer-mediated communication) that one would expect of an IT-literate individual.

Certainly, the terminology has evolved as the techno-

logy has expanded steadily into everyday life. Back in 1970, the UGC/CBURC Report [11] legitimately spoke in terms of the 'need to stimulate the teaching of computing (as) an urgent matter' and proposed 'that a scheme to provide introductory courses should be started as soon as possible', with the belief that 'a major consequence of it, and one to be welcomed and encouraged, will be a rapid growth in the application of computing by undergraduates to their main studies'. At the time of the Nelson Report [2] (1983), even if progress had not been as rapid as envisaged in 1970, the concern remained the provision of computer facilities to support teaching (proposing a ratio of five students per computer workplace by 1990), and on the need for corresponding staff training—still, however, with the emphasis on institutional purposes for computers rather than on enabling students to use the technology for their own learning purposes.

A change of view is detectable, however, in the IUCC Report [5] (1991) where, emulating the Nelson Report's crystal-gazing, a listing is offered of the various computer-related qualities felt likely to characterize the HEI of the future (1996), including: all graduates using IT in their courses; all student working rooms networked; significant use of e-mail for staff–student and student–student communication; greater use of on-line teaching softwares; and financial schemes to enable those students who wish to do so to acquire their own IT facilities. The scope for action to develop broad-based IT skills was indicated in the IUTC Report [6] (1992) which, amongst its observations on IT training for staff (its main focus), made reference to the wide distribution of responsibility it had found for undergraduate IT training (largely left to academic departments), raising the questions 'whether this data (on undergraduate IT training provision) is available anywhere in the institution, and whether anyone knows what IT training really is being given to these students'. Yet the Report goes on to suggest that IT training provided by HEIs will be a critical background element to the future employability of their students—and will be a major influence in determining student interest in studying at the institution (a view shared by the 1992 HMI report on *Information Technology in Initial Teacher Training* [3].

The Middlesex decision to promote IT literacy in all students took as its working definition of information technology 'the acquisition, storage, manipulation, transmission, display and use of information by electronic means'. This still leaves open the question, however, of what do we mean by literacy? Clearly it is more than just an awareness of ('knowing about') computers and having the acquired skills to perform a few operations on a few software packages—'to word-process assignments and maybe to import a spreadsheet layout' as one student suggested (reflecting, incidentally, the high regard students have for word-processing as a manifestation of IT). These abilities by themselves barely take their possessor beyond the lowest two levels of cognitive operation (knowledge, comprehension) in Bloom's *Taxonomy of Educational Objectives* [1] whereas graduates would normally be expected to be able to operate at the higher intellectual levels of application, analysis, synthesis and evaluation. So, in a manner akin to that whereby a conventionally literate individual can extract meaning, determine actions, perceive implications and assess significance from words and syntax, the IT literate individual should (ideally!) be equipped to move beyond basic understanding to display an attitude of enquiry, demonstrate initiative and self-development in IT knowledge and skills, see personal uses for IT in a range of situations (study, work or domestic), envisage and speculate on possible futures and new uses of IT, and be able to analyse and evaluate attitudes and values associated with the technology and its applications (e.g. in terms of its social and environmental impact and repercussions).

The full range of necessary IT competences will vary from discipline to discipline. What needs to be teased out and identified is an 'essential core' of generic components to which all students should be introduced and on which subject-based courses can build. For evidence from student feedback [10] suggests that subject courses, left to their own devices and interpretation, can inadvertently impart an unduly particular and unbalanced version of IT; whereas the alternative scenario, that of IT teaching on subject courses by 'imported' IT specialists, can equally be at risk of excessive emphasis on hardware and software skills at the expense of consideration of real-world applications and situations pertinent to the subject (and thereby to the student). No-one doubts that, for IT to be fully experienced, it has to become woven into the fabric of courses where 'the best way to impress on students the importance of IT is to let them see it used, and have it taught, by staff from their own subject area, not by IT boffins', as one lecturer expressed it. A case remains, however, for the proposition that all students should receive a value-free introduction to IT and that this introduction should be an enabling experience, one that engenders confidence, rather than be one that focuses on delivering specific detailed IT knowledge—given a glimpse of IT's potential, and the confidence to go and look further, students will determine their own personal pattern of IT usage and development. Or, as an enlightened student put it, 'It's not what you know, it's not what you can do, but what you can do with what you know and can do'.

3. MIDDLESEX UNIVERSITY: BASIC IT (PAST)

Middlesex University is a large, multi-site institution (13500 students, over 100 courses) with six major campuses spread across north London. For some years much of its teaching (in the Faculties of Humanities, Social Science and Education & Performing Arts) has been delivered via the Modular Degree Scheme (MDS) whereby students pursue a study pathway from modules

offered by a number of subject sets, with most modules being of a semester length (two semesters per year). One of the available sets is that of IT. The University is currently implementing a 'Common Framework' whereby all its undergraduate teaching will take place within a modular and semester-based scheme of operation.

In its first (1989) Corporate Plan [7] Middlesex University (then a Polytechnic) identified the need 'to prepare students for changing patterns of career and skill needs including information technology', and expressed the intention that IT should be a component of all courses by 1992 (a prediction that has suffered from the same slippage problem as those of the Nelson Report). The intention was expanded in the subsequent (1990) 'IT Strategy' document [8] which stated that 'The commitment to IT mirrors the changing emphasis in the outside world towards an information based society requiring people with IT knowledge and skills who can contribute effectively and imaginatively towards new developments' and gave a 'commitment to providing training in IT as a significant part of all courses. This must be accompanied by a commitment to provide training for teaching staff and first class facilities and suitable support...'. This early recognition of staff training and resourcing issues reflected staff observations at the time: views like 'Students are not the problem, staff are the problem. Staff education in some of these areas (IT) is a *major* problem' and 'What we really need is not sophisticated equipment—but lots of it!' were typical observations [10].

Fortunately, some efforts were already being made in some quarters to provide students with basic IT skills, and these provided valuable ideas and experience for developing a strategy to address the challenge of developing IT literacy across the institution. Within the MDS it had been determined that the first-level (Foundation) module in the IT Set should also serve as a basic IT introductory module for all MDS students who chose to take it (or were advised to take it) for its relevance to their work in other sets; meanwhile, in the Business Faculty, a 'core' IT syllabus was being delivered (by IT lecturers) within the subject courses being taken by undergraduate students. (In addition, one subject set within the MDS had devised and operated its own IT-focused module catering specifically to the IT needs of its students, taught by its own staff).

A planning group was established, with representation from the Computer Centre, from the School of Information Systems (responsible for IT teaching) and from the Academic Development Unit, to investigate the feasibility of a common approach. It initially identified four possible different focal (content) areas of 'IT basic skills':

(a) familiarity with universal tools such as word-processing, spreadsheets, data management, desk top publishing (DTP), etc. (subsuming basic ability to operate equipment).
(b) A general appreciation of the potential of IT as a tool for competitive advantage.
(c) Working knowledge of specific relevant packages (e.g. vertical financial packages for students of accountancy).
(d) Ability to use CAL tools for interactive learning (although it was recognised that this would initially be a matter of staff development rather than of student relevance).

Against these categories, the MDS introductory module was judged to be aiming to cover (a), (b) and elements of (c); in comparison, the Business courses' 'core component' approach (taught by IT staff) covered (a) and (b), with category (c) left to appear in each individual course in the way felt most appropriate to that course (and to be taught by the subject teachers for that course).

The group also came to recognise that, mirroring category differences based on content, there was difference based on the function of IT instruction—whether it was:

(i) Teaching students the principles of computing/IT as a specialized subject in its own right (e.g. teaching computer science to computing specialists) involving a clearly focused, comprehensive IT programme and syllabus, to be taught by IT specialist staff.
(ii) IT taught as a subject in its own right but here as a significant part of, or in clear relation to, a greater whole subject (e.g. an Information Systems specialist option within a Hotel & Catering course), with sufficient level of IT specialism to require teaching by IT staff.
(iii) IT featuring as a part *within* another subject (e.g. IT as it is likely to be encountered or used in the subject workplace by non-IT specialists), not needing specialist IT teaching because the application/usage is more important than the IT *per se*.
(iv) IT as 'personal skills' with the emphasis on IT as a tool (word-processing, database, spreadsheet, data storage media, communications, etc.), taught within main course areas by non-IT specialists (enhances student perception of value and applicability of IT)
(v) IT as a medium for instruction and learning—an introduction to CAL, CBL and associated approaches.

An analysis of the two approaches (MDS/Business) concluded that:

1. Use of a single module (MDS) to deliver basic IT skills to generalists and at the same time to serve as a foundation course to intending IT-specialist students, resulted in a conflict of interest—one that was rapidly noticed and commented on by students ('IT100 seems to be two different and incompatible courses lumped together'). The generalists complained of too heavy an emphasis on hardware and software,

and too little on subject-relevant applications and IT as an element of personal skills, while the specialists complained of being held back in developing more advanced technical skills. (The module designed by one set for its own students fared little better—it was not recognised by other sets, notably the IT Set itself, as meeting their IT requirements of students and so held no currency outside its own subject sphere—students wishing to 'prove' IT capability still had to take the designated IT module in order to meet pre-requisites in other subject sets).

2. The 'core component' approach where IT instruction took place within subject courses (Business) had a tendency to take on different emphases and character in different courses (notwithstanding its delivery by IT lecturers), with risk of providing an uneven appreciation of the various skills comprising basic IT, and perhaps being too narrow and too subject-focused with (again) little attention to the personal skills dimension.
3. Different subjects/courses have a valid claim to their own definition of what is basic IT in terms of their own students. In a like manner, the teaching of (a), (b) and (c) requires very different abilities from the lecturer.
4. Identification, therefore, of a 'common IT component' for all students would have to be in terms of a *very* basic package of skills and knowledge, including personal skills, and would be likely to be based upon category (a), with (b) and (c) being left to individual courses, sets and modules to define and deliver.
5. All students should be expected to achieve a basic set of competences relating to this 'common IT component', but these should not be separately examined; instead, evidence of their achievement should be sought via work done for the students' main subject studies. Students would be required to work at their IT capabilities until such time as these broad competences had all been demonstrated.
6. It is inappropriate to assign basic IT teaching across the institution to IT lecturers, particularly in view of the value of students seeing their subject teachers using the technology. Instead, IT specialist staff could contribute to the necessary staff development of subject teaching colleagues.

4. MIDDLESEX UNIVERSITY: IT LITERACY (FUTURE)

The outcome of the analysis was that a key distinction exists between 'IT literacy' which incorporates the essential IT relevant to the subject studies of each individual student (but excluding specialist computing skills *per se*) and a truly fundamental 'IT For All' (ITFA) component which would be common to *all* students—akin to what the IUCC Report [5] referred to as 'learning about computing' (as opposed to 'learning with computing' and 'learning through computing') and an extension of category (a) as defined initially by the planning group (above).

Specifically, the analysis suggested that fundamental 'ITFA' has to cater for students in a range of disciplines and with widely differing levels of IT motivation. Its key outcome in student terms is possession of the basic skills, the confidence and the attitudes that will enable students to then pursue their own path of IT development within their particular subject studies. In such terms, all students need to be able to:

1. Perform basic operations to initialize and use basic equipment (microcomputer/terminal, printer, disk drive, etc.).
2. Create, store and manipulate data using one variant of each of the three basic software packages (word-processing, database, spreadsheet).
3. Utilize the communications potential of IT (including information searches making use of public database and information systems).
4. Offer opinion on the past and potential impact of IT in personal, technological and societal terms.

The 'ITFA' syllabus should be a genuine 'core' and should bridge the two extremes of being so vestigial as to be valueless and of being so thorough as to intrude onto areas that subjects/courses would legitimately wish to develop in their own way (and it should certainly avoid becoming simply the means for students to be able to word-process their essays, with all the consequent low-level usage of IT facilities that that engenders). The proposed syllabus content is outlined below (there is no implication in this listing that 'elements' are of the same weight or duration; and it is assumed that students have, or will acquire, keyboard skills by other means). Appropriate learning methods would be expected to reflect a strong emphasis on practical (workshop) activity and student-led discussion groups:

Element 1—the technology of the computer (how it works): keyboard, monitor, CPU, memory, etc. Sufficient to understand: why a computer operates as it does; what it can/cannot do; the requirements it places on users; the language of computing (terminology). The premise is that some appreciation of the 'structure' of computing will assist students to understand how to use computers and why certain procedures are necessary.

Element 2—practical experience of operating a microcomputer: basic operations and instructions; loading packages; retrieving/storing data and files; using peripherals (printers, storage devices, etc.); using networks. As a basic requirement, students should be confident and capable enough to switch on a microcomputer or terminal, deal at a basic level with the operating system, load software packages for use and recall/store data on storage media. Plus simple 'help' and 'recovery' procedures, and how to use a hardware/software manual. The essence is to generate confidence in a

student—at the least, that he/she cannot (usually!) damage anything.

Element 3—key software packages: the nature of the three basic software package types (word-processor, database and spreadsheet); their uses and applications. The goal is to give all students adequate experience of using one package of each type so that they would subsequently be able to make an informed decision as to applicability and usage in their work (and be sufficiently confident to implement this decision). In addition they would hopefully acquire the confidence and motivation to transfer their skills to other packages.

Element 4—IT for information and communication: major public (and private) databases; the 'electronic library'; CD-ROM; CD-I; e-mail; networks; communication technologies and their uses (modems, fax, eftpos); data security; (possibly) an introduction to learning via computers (e.g. Accutype for keyboard skills; more advanced learning packages)

Element 5—the social and individual context of IT: the development history of IT and computers, current impact, and possible future scenarios. Some background is felt necessary if students are to be able to contextualize and evaluate IT in their studies, in everyday society and at work. However, such an element should be brief and should concentrate on provoking thought and reflection.

The analysis, then, revealed that a real need exists to 'demystify' the technology and to give *all* students at the University a balanced introduction to IT as the foundation for subsequent elaboration and development. Accordingly, a recommendation was made for the incorporation of 'ITFA' within a broad-based 'Common Skills Module' to be taken by all students in their first year, introducing them to the wide range of personal skills that contribute to personal development and to learning effectiveness (with communication skills being prominent). For, as Wellington [12] observes with regard to 'education's other role, the development of the individual, IT can play a hugely important part which is rarely stressed by educators in their activity to stress (mistakenly) its vocational significance. Information technology can develop and enhance personal qualities: team work, communication skills and, of course, the immortal numeracy and literacy'. Advantages of such a common module included: the avoidance of needless duplication of basic instruction (IT and other skills) in foundation modules in different subject sets; the ability to integrate IT in with other basic learning skills and attitudes; the allowance of some flexibility for individual student needs and skills; and the potential to spread the load of demand for access to resources and equipment.

This concept of a 'Common Skills Module' has not been accepted, for a variety of reasons (not least its implications for the existing structure and nature of University first-year teaching), although there are still those who see merit in its broad aim and the cause may not be entirely lost; and so the locus for basic IT provision has remained with subject courses and the IT Set. This is not without its implications and repercussions: foundation level subject modules could now have to find time to arrange for, if not incorporate, basic IT instruction, while students might find themselves facing duplicate, or even triplicate, basic instruction across different subject sets. This must clearly be avoided, even if a ready solution is not immediately to hand. Various mechanisms suggest themselves whereby, for example, 'ITFA' instruction could be taken, in effect, outside of the subject modules themselves: packages of self-instructional materials (resource-based learning, if not CAL) could be prepared by subject staff; or 'supplemental instruction' or mentoring provision could be made whereby advanced or postgraduate students could run basic IT workshops for first-year novitiates. The problem then becomes one of organization rather than of direct delivery; the critical point, however, is that the *assessment* (i.e. demonstration of competence) of the basic IT skills will take place via the work for the subject modules, and students will know of this requirement and so be motivated to learn.

If specific suggestions of the group were not accepted, overall the work had aroused interest and had succeeded in raising and disseminating ideas in the institution, not least in terms of bringing IT literacy into the arena of course monitoring and review procedures: by proposing a core IT syllabus for all students, a 'virtual module' had been identified that all courses and subject sets could seek to deliver, and against which their provision could be evaluated. Furthermore, the issues identified, particularly those of staff development and of equipment/resource implications, were duly incorporated within the remit of another task group set up by the University to make recommendations on the whole topic of an institutional IT strategy.

5. THE INSTITUTIONAL IT STRATEGY

Permeation is not a natural phenomenon: it needs time, planning and deliberate implementation to be fully effective. [4]

If the day-to-day implementation of IT literacy for all students remains largely a curricular matter to be resolved at the level of courses and sets, the implications for the HEI of introducing this policy are significant, particularly in the areas of staff development and of resources. Yet the 1992 IUTC Report [6] on a survey of 29 institutions (corresponding to 55% of IUTC correspondents, including over some 48% of 'old' universities) notes that 13 (45%) had 'neither objectives, strategy nor a statement on intent concerning IT training' for academic staff and students, while 'nine institutions (31%) have neither objectives, strategy nor stated intentions for *any* sector of staff or students'. Lack of statement does not mean lack of provision, certainly in terms of

resources, but it does suggest that some HEIs may not be fully alert to direct this curricular advance.

At Middlesex University two task groups were set up to identify, and make recommendations on, the range of issues that need to be addressed in devising an IT strategy for the institution. One group was specifically asked to focus its attention on the essential matter of staff training, both academic and non-academic; its conclusions are not yet published (but will relate heavily to Middlesex University's particular circumstances and needs). The other task group, under Professor John Lansdown, was to undertake a review of the current and future needs of IT provision to support the academic programme of the university; its report [9] addresses a broad range of issues that have wider relevance. It is not possible or relevant to refer to all its findings and recommendations but certain key themes emerge, notably with respect to resources and the manner of their provision.

Four basic modes of computer *usage* were identified:

1. *Specialist category*—students and courses where computing is either studied *in its own right* or is *specialized and central* in other subjects (e.g. computer-aided art/design) whereby student work is dependent upon mastery of it
2. *Generalist category*—IT techniques are used to *assist* in the carrying out of subject tasks (statistics, information retrieval, data analysis, engineering calculations, DTP, etc.)
3. *Literacy category*—where IT is needed by students to *facilitate* researching, recording and presenting the results of their studies
4. *Learning category*—where IT is used as a *teaching and learning medium.*

Within category (3), the minimum expectation of student ability to use IT facilities (as in 'ITFA') would be that he/she:

(i) Could create word-processed text, draw simple diagrams and charts, use a spreadsheet, integrate elements from all of these into a well-designed document, and transfer data from one hardware or software platform to another.

(ii) Would possess 'a basic understanding of the differences between hardware and software; an awareness of the roles played by different types of software; a practical awareness of proper uses of security and back-up; and sufficient knowledge of computing to enable (him/her) to form a literal rather than a magical view of the human-machine interface. Furthermore, (he/she) will be able to scan the library OPAC and CD-ROM databases with ease as well as deal with networked information systems including e-mail. As much as anything else the aim of computer literacy training is to ... give students and staff confidence in the use of IT (and to) provide awareness of the rich range of possibilities that IT offers to teaching and learning'.

(iii) Would be expected to have an awareness of social and environmental considerations and implications.

This extension of IT into all areas of the curriculum for all students, whether as a basic set of abilities ('ITFA') or as a fuller, subject-focused IT literacy, coupled with an intention that all students will be computer literate from 1995, raises key issues of institutional implementation and of costing:

(a) Nelson [2] suggested that one identifier of an 'advanced' HEI in 1990 would be a ratio of five students per computer workplace. As the 1991 IUCC report noted, few institutions have achieved this and most are some way from it. Middlesex is no exception, but it has now identified the achievement of an average ratio of 5:1 (and 4:1 ideally) as a 5-year target, with perhaps some variation between subject areas. This will bring it up to the Nelson levels, at which point it is calculated an annual expenditure of some £125 (at least) per student per year will be required to maintain the adequacy of provision of up-to-date equipment and softwares; to reach this level initially will require expenditure above this rate (but see also (e), below)

(b) The notion of a 'computer workplace' covers a range of possible realities. Three major types of institution-based provision are envisaged:

  (i) Clusters of networked workplaces in Campus Learning Resource Centres aimed at students who primarily have a need for routine work on an open access 'drop in' basis—microcomputers of a comparatively simple and low-powered form.

  (ii) Clusters of networked workplaces in classrooms which are largely on open access but which can be reserved by staff for teaching use—medium to high-powered microcomputers.

  (iii) Clusters of networked machines for the exclusive use of certain groups of students, staff and researchers—high-powered microcomputers and professional workstations.

(c) IT teaching will need to reflect the two existent platforms at Middlesex (IBM/Macintosh); but, given that most data (and even some programs) can be transferred between the two systems, this is not seen as a major problem. Both will exist in sufficient numbers to benefit from economies of bulk purchase and from the subsequent benefits of standardization.

(d) Networking and e-mail provision will need to be substantially increased, including the networking of student bedrooms in halls of residence—a goal identified in the 1991 IUCC Report [5]. (The question of whether all rooms should be equipped with PCs is yet to be resolved—there are questions to be considered of unfair advantage relative to students

in private accommodation; but the cost factor could render such a scheme cheaper than other means of providing PCs to students if workplace establishment costs are taken into account—see (e) below.)

(e) Obsolescence is a major issue. High-powered equipment is likely to lend itself on a 'hand-me-down' basis to more general uses, but the institution cannot afford, and does not want, to make a massive investment in fairly basic machines that can rapidly become outmoded. Even a well-balanced cycle of replacement will consume large amounts of resources, so it is important both to maximize prudence of institutional purchases and provision (it has been calculated that the real cost of installing a PC workplace and keeping it functioning, allowing for space, furniture, maintenance, heat, power, etc., could be as high as £7000) and to be aware of other possibilities that largely obviate this need. In a future, for example, of largely distributed learning to students possessing their own PCs, numerous large IT-equipped classrooms may become institutional white elephants.

(f) One solution to the problems of (e) would be to encourage, or require, students to have their own computers—if not PCs, then certainly simple notepad devices (currently, e.g. the Amstrad NC100 or Tandy WP-2) which would serve for students to store data and to perform simple text and other operations. Such machines have serious limitations, however, and would still require the University to provide a large number of PCs (and peripheral equipment) to allow students to produce their final work; in addition, there is serious risk that constant connection/reconnection would result in mechanical damage to plugs/sockets, with significant maintenance and repair consequences. So maybe the answer, as already happens in the USA, is to promote PC ownership among students, either as desktop or laptop machines, by financial aid schemes, by subsidy or even as a 'gift' by inclusion in course fees. The problem is that the advantages and disadvantages of such schemes are numerous and difficult to evaluate—would they attract students because of their innovatory nature (and perhaps the provision of a 'free' computer) or act as a discouragement through higher course cost? How to set this against institutional benefits (avoids the problem of obsolescence and reduces accommodation demands) and penalties (softwares, security, insurance, maintenance obligations, viruses, etc.). The University plans to run a pilot scheme to test out the efficacy and benefits of such an approach based on providing students with 'their own' computers.

(g) A major increase in students using IT equipment raises other issues: software purchase costs (packages or licences) and software piracy; data security and the possible introduction of viruses; insurance against loss and breakage; the cost of increased opening hours of buildings (heat, light, personnel, etc.); increased consumables costs; and significant increase in cost of technical support to maintain the large numbers of computers and (not insignificant) the associated peripherals (estimated to be required at a ratio of one printer per 15 PCs, for example).

(h) Staff training is critically important but must be accompanied by ready access to IT facilities if the learning is not to be rapidly forgotten; but the institution cannot afford to train all staff/provide them with necessary hardware and software all at once. So there may be need to devise some means of identifying and 'targeting' certain groups or categories for training and equipping. If the aim of the exercise is to then see IT being introduced into teaching, there is some sense in identifying target groups in terms of their subject focus—but other schemes could be as easily envisaged and none will make it significantly easier to determine priorities or precedence to everyone's satisfaction.

(i) In terms of student learning of basic IT, it needs to be asked whether this is a proper use of time in a higher education programme, particularly if it takes time from conventional subject teaching. The reality, however, is that, whatever the future may bring in terms of better equipped school-leavers, there is a serious need in the foreseeable future for some provision to introduce students to these skills. Various different approaches merit exploration: evening and/or weekend courses (for staff as well as students); pre-enrolment courses (for those needing them); CAL-based materials; and greater use of suitable senior or postgraduate students as teachers of beginners ('supplemental instruction'-type schemes).

(j) Added value could be given to the training provided (staff and student) by some recognition of the competences gained—an institutional certificate or diploma, maybe with relation to an NVQ (National Vocational Qualification) award.

6. CONCLUSION

Middlesex University has determined that all its students shall be IT literate from 1995. It recognises that fundamental IT literacy ('ITFA') is more than just operational proficiency in the use of microcomputers, associated peripheral equipment and basic software packages, but includes an understanding of its communications uses and wider social implications. It recognises too that full IT literacy for any individual student will include fundamental subject-focused applications of the technology—that in the fullest sense IT literacy needs to 'shadow' development in subject and specialist areas—and that people learn best when they see the technology employed, and have their own chance to use it, in their main work areas. It follows, therefore, that assessment of IT competence is best located where the IT skills and understanding will be used—but that there needs to be some mechanism

to ensure that any subject-based delivery does not inadvertently become too narrow, and that all students are given an adequate broad grounding and a general IT confidence. Which brings us back to the determination of the essential core of 'ITFA'. Staff development is one half of the key to institution-wide implementation, and presents its own challenges and dilemmas; appropriate and adequate provision of hardware and software is the other. For successful implementation, a clear policy is needed, and is needed to be seen to have unequivocal backing from the top management levels of the institution if a realistic timescale is to be set and achieved.

Provision of IT literacy will be expensive—but so is the opportunity cost, in terms of student learning, of *not* providing it. There can be very few courses that can claim that their syllabus will serve their graduates for their working lifetime—or even for a few years of it. Rather, it is the nature of the 'graduate intellect' that is the real product of a good higher education and the associated generic skills that allow the intellect to be effective. Within these generic skills IT competence will have an increasing part to play; it is important that we get IT literacy right in our curricula, in all subject areas, if we are to equip our students fully, not only for their work in educational institutions but also, and more importantly, for all aspects of their life thereafter.

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