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Trends and Tensions in IT Policy in Universities

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Abstract

This paper charts developments in information technology policy in British universities from the creation of the Computer Board for Universities and Research Councils to the present day. Focusing on institutional issues, the various organizational tensions are examined in the context of quasi-collegial policy formulation and management. The impact of operational tensions, arising from a variety of external and internal influences on the implementation of policy, is similarly assessed. The paper concludes with an outline of likely future trends.

Policy Landmarks

The major landmark in the development of information technology (IT) policy in British universities was the establishment of a body charged with monitoring, coordinating and overseeing the funding of all issues relating to computing. The Computer Board for Universities and Research Councils (known simply as the Computer Board) was founded in 1966 with a remit to:

> . . . carry forward on the basis of planned development, allowing for modular growth and compatibility, the proposals for providing computers for research in universities and research councils . . . (HMSO, 1965).

The word *research* is of particular note here. Although it was to change substantially in subsequent years, the Computer Board's original remit was to support research, with no mention of teaching. It was not long before this issue was highlighted by a joint working party instituted by the University Grants Committee (UGC) and the Computer Board. The Barnard Working Party considered that '. . . the Board's terms of reference have discouraged use of computers for teaching except on a relatively small scale' (Barnard 1970, p. 4).

Barnard went on to recommend that the machines provided by the Board should also be used for teaching but stressed that they should not be provided solely for that purpose. Another feature of the report was its focus on the use of computers in teaching outside the traditional area of computer science. Perhaps for the first time an influential body was recommending that all undergraduates should receive some experience of computing:

> The need to stimulate the teaching of computing is an urgent matter and we recommend therefore that a scheme to provide introductory courses for *all* undergraduates should be started as soon as possible (Barnard 1970, p. 1).

The terms of reference of the Computer Board were in fact extended in 1970 to cover teaching as well as research and during the next decade there was some attempt to develop computing in education under the auspices of the National Development Programme for Computer Assisted Learning (NDPCAL) (Hooper 1979).

The impetus for NDPCAL came from recommendations made by the National Council for Educational Technology (NCET), that the government should sponsor a five year research and development project in computer-assisted learning. While the Barnard Report had advocated that students should take an introductory course in computing, NDPCAL aimed to integrate the use of computers into the teaching of other subjects. The programme was not confined to universities however and included primary and secondary schools, colleges of education, industrial training schools and military training establishments. The project ran for almost five years and involved forty-seven institutions in twenty-nine projects. Although it had its detractors, NDPCAL had some success in consolidating the network of computer assisted learning developers which at that time included the Computer Based Learning Unit at Leeds and the Educational Computing group at Chelsea College. Unfortunately for NDPCAL, however, the initiative missed the microcomputer revolution. As NDPCAL was ending in 1977/8 the first prototype microcomputers were entering the market and for the next four years or so, the desktop microcomputer was to change the face of computing radically.

In the year designated Information Technology Year by the then government, a report of the Department of Trade and Industry's Alvey Committee made the following blunt appraisal of the teaching of computing in higher education: '. . . the rôle of the tertiary education sector in relation to computing is currently confused. There is too broad a spread of standards and courses do not match needs' (Alvey 1982, p. 62).

While Alvey was chiefly concerned with *experts* and *expertise* in IT the UGC's Mathematical Sciences Sub-Committee's report on computer science echoed Barnard by focusing attention on the importance of providing computing skills for all undergraduates, noting particularly that '. . . in Arts and some Social Sciences progress has been slow. Now that more research involving computing is being carried out in these areas it is to be hoped that space can be found in the undergraduate timetable for a subject which, while possibly peripheral to the principal course, *can scarcely be avoided in later life*' (Jones, 1982, p. 4).

The reference (our italics) to some form of computing literacy as a necessity for post-university working life is a recurring theme which had been aired quite persuasively by Barnard twelve years earlier (1970, p. 5) yet Jones concluded that large numbers of students still had no computing contact.

This issue was addressed more fully in the Computer Board's review of computing facilities for teaching in universities in the following year. Looking in detail at the practicalities of introducing all undergraduates to computing, the Nelson Report (1983) considered such issues as staff development and the type and funding of hardware and software. One conclusion of the report was that the provision for non-computer science students was still inadequate and would not '. . . allow the development of skills and knowledge required to meet the future needs of people leaving university to work in industry, commerce or public administration' (Nelson, 1983, p. 7).

The Nelson Report is perhaps best known for its recommendations which included the setting of a target of one computer workstation per five undergraduate students by 1990 (Nelson, 1983, p. 23). By 1989 only one university (Surrey) had reached the target although another five were at levels better than 1:8 (Dolton, 1989). By 1991 the picture had changed very little with only half of universities reaching a 1:10 ratio and only three making the Nelson target (IUCC, 1991).

Throughout education as a whole, the early 1980s saw a build-up of pressure for the development of computing in teaching and learning and in the schools sector a number of initiatives were sponsored by the Department of Education and Science (DES), complemented by hardware initiatives from the Department of Trade and Industry and research initiatives from the Economic and Social Research Council, ESRC. The DES initiatives included the Microelectronics Education Programme (MEP, 1982–86) and the Microelectronics Educational Support Unit (MESU, 1986 to date) now subsumed under NCET. Research based initiatives undertaken by the ESRC included the Information Technology

and Education (ITE) Programme (1985–88) and the Information Technology in Educational Research (InTER) Programme (1988–92). Prompted by the Nelson Report the Computer Board, along with the UGC – later to become the Universities' Funding Council, (UFC) launched the Computers in Teaching Initiative (CTI) for the university sector in 1985. The aims of the initiative were stated as being to:

- encourage the development of computer-mediated training and learning in UK universities;
- evaluate the educational potential of information technology within the context of university teaching in the UK; and
- promote an enhanced awareness of the potential of information technology among academics and students in all disciplines. (Gardner, N., 1988)

In the first phase of the initiative some one hundred and thirty-nine 'computers in teaching' projects were supported from a fund of £9.5 million while the second phase, beginning in 1989 and extending to July 1993, saw the establishment of twenty national centres charged with the responsibility to 'enhance the quality of learning and increase the effectiveness of teaching in all subjects within the UK university sector through the application of information technology.' Each centre was created to promote the use of computers in the teaching of a specific discipline and covered a range of subjects including accounting, medicine and law (for the breadth of activity see Darby *et al.* 1992). The success of the centres in meeting their objectives prompted a working party of the UFC's Information Systems Committee (ISC) to comment that the CTI was 'performing a much needed service in an excellent and cost-effective way' (ISC 1991).

Even as the CTI has progressed, two major IT initiatives have been entered into by British universities. The first of these, the Information Technology Training Development Initiative (known as ITTI) was launched by the Computer Board in 1990 and was aimed at funding up to twenty projects at the level of £30–50,000 per annum for up to three years beginning in the Summer of 1991. More recently, August 1992, the UFC provided £7.5 million for forty-two major courseware development projects under its Teaching and Learning Technology Programme (TLTP 1992a). The ITTI is designed to tackle the need for improved IT 'training materials and products' to help computer centres cope with the 'steadily growing demands on them brought about by the wider use of information systems' (ITTI 1990) while the TLTP is squarely aimed at improving

'productivity in higher education through more efficient delivery of teaching and more effective learning' (TLTP 1992b). Unlike the earlier initiatives, which were clearly aimed at enhancing the quality of the learning experiences provided for students, TLTP was unashamedly targeted at providing university education as cost-effectively as possible. This includes not just the development of new methods of using IT to teach increased numbers of students, without a proportionate or even any increase in staff numbers, but also the more cost-beneficial management of such resources as space, equipment and the computing support services.

The Nelson Report had also been instrumental in bringing attention to bear on '. . . the need to use information technology in the working life of the institution; in its administration, communications and day-to-day activities' (Nelson, 1983, p. 9). IT clearly has a major role to play in at least three such areas: library administration and automation; management and administrative information systems (generally referred to as MIS) and infra-structural computing facilities (networking and so on). With the changes in university management structures and policies, arising primarily from the recommendations of the Committee of Vice-Chancellors and Principals (CVCP) Steering Committee for Efficiency Studies in Universities (Jarratt, 1985), MIS-related areas of university activity began to attract much more attention. As a result, in 1988 the then UGC and the CVCP established the Management and Administrative Computing (MAC) Initiative (see Campbell, 1989). In the first phase of the project they commissioned a team of consultants from Price Waterhouse to carry out a study of the systems in use in university administration, with a view to identifying future needs. They subsequently identified six broad application areas:

Management Information Systems
Student Systems (eg. admissions, registration, examinations, accommodation);
Staff Systems (eg. personnel functions, salaries);
Finance Systems (eg. income and expenditure ledgers);
Research and Consultancy (eg. contract costing and management);
Physical Resources (eg. room and space usage, equipment inventory).

The first is seen as the overarching concept, of which each of the others forms a part, and which facilitates planning functions such as budgeting and expenditure forecasting. To get round the estimated one hundred and twenty person-years necessary to develop the software a system of 'families' was instituted whereby universities could choose to be in a group

or 'family' of institutions which would collectively contribute to the development of software on the same hardware and database platforms (the software choice being Ingres, Oracle or Powerhouse). In this manner, the programme also aims to provide overall standards for administrative computing between universities while promoting greater consistency within the individual institutions. A major design emphasis in the MAC project is that it remains user driven, i.e. that the administrators rather than computing experts design the system according to their own requirements. Overall, MAC is considered to be a more cost effective approach than that of letting the fifty-plus universities develop individual systems of their own.

Developments are also moving forward rapidly in library management. Catalogue and issue systems are now computerized and routinely available to users through 'on-line public access to catalogue' (OPAC) systems. According to a recent Inter-University Committee on Computing report (IUCC, 1991), there has been 'almost complete achievement' by fifty-two universities, which had responded to their questionnaire, in providing facilities for students to obtain on-line access to library catalogues. In many universities the library catalogue is available to staff and students from the ordinary campus network workstations while the developments in inter-academic networks have brought shared access to library resources between groups of institutions.

Wherever staff and students need support or access to IT facilities in the four areas (academic, MIS, library and campus infra-structural IT facilities), there are immediate problems related to the choice of systems and the provision of support in terms, for example, of training, guidance, technical assistance and maintenance. To some extent the development of institutional policy and implementation procedures can be expected to offset some problems (particularly in 'controlled' settings such as the administration or library) but where there is no naturally established conformity, for example, in the various teaching contexts, there may be many more problems. The development and implementation of a sound institutional policy can often face a variety of organizational and operational tensions.

Organizational tensions: forming and managing an institutional policy

The Universities' Funding Council (UFC) and its Information Systems Committee (ISC) have had a strong influence on IT policy within universities. In its previous form as the Computer Board, the ISC required

universities to produce a statement of computing strategy every seven years. This would normally involve a visit by Board representatives to review strategy and to ensure that the policy reflects the requirements of the users. In this manner the Board would exercise considerable control over university IT procurement policies with a central coordinating role in setting standards, approving equipment and providing the funds. With the funding council changes coming into effect in 1992/93 a number of changes are likely in the management of national higher education computing.

The major change will be the removal of earmarked funding for computer centres with IT funding being incorporated into each university's annual 'block' grant instead. The ISC will continue, although not in its current form, to oversee national IT developments such as networking and any emerging areas of national interest. They have proposed a joint information systems committee (the JISC) with a £30 million budget from the funding councils (HEFCs) for England, Wales and Scotland – acting only in an advisory capacity for the Department of Education for Northern Ireland (JISC, 1992). For local procurements, which are set to fall from a seven to a two year cycle, they would continue to act in an advisory role to institutions. One important area for which they are likely to have responsibility is that of assessing institutional performance in the IT field. The sorts of performance indicators which have so far been mooted include: the numbers of full-time equivalent students per workstation, the institution's incoming and outgoing traffic on the Joint Academic Network (JANET), the take up of Consortium for Higher Education Software Trust (CHEST) hardware and software procurement deals, the level of user satisfaction and the use of national services such as those available for supercomputing. Just how such performance indicators will be used to calculate IT elements in the block grant formulation is as yet unclear.

Until comparatively recently many institutions had no formal policy making body for IT nor any definite IT strategy apart from that required for the seven yearly submission to the Computer Board. In fact, in a recent survey of fifty-five universities, only sixteen said that they had a strategy but '. . . significant numbers of institutions have recently set up IT committees which have, as their main rôle, the development and overview of IT strategies' (IUCC/SCONUL, 1990).

Universities have traditionally been characterized as having a collegial style of management, relying strongly on consensus building and participation in decision making. This approach is based on the principle that consultation and the opportunity to participate in decision making are

more likely to generate commitment to the decisions reached in an environment staffed by professionals than a more directive and top-down style. Whatever the particular advantages of such approaches, most now recognize that in current circumstances a more complex combination of bureaucratic hierarchy and collegium is necessary. Others have suggested that the new directions in higher education have created the need for so-called 'organized anarchy' or 'political' models (see Becher and Kogan 1980, p. 64; Davies and Morgan, 1982, pp. 154–5). The former are considered to arise from the operational ambiguities of a collegial/bureaucratic system and the latter from the negotiated compromises necessary in a system of conflicting interest groups. As a result of the Jarratt Report, the structure and style of management has tended to be come more centralized and directive, yet it is curious to note, given the 'knowledge is power' axiom, that many institutions (IUCC/SCONUL, 1990, p. 4) still use a relatively representative committee approach to develop IT policy. IT seems to harbour so much complexity and risk that perhaps it is still considered sensible to seek safety through policy development by consensus.

Many institutions, then, invest the primary IT policy making process in specially constituted committees drawing their membership from the academic, administrative and computer services ranks and usually including the Director of Computing (or equivalent) and the Librarian. The role of such committees is to evaluate policy options (in terms of cost, fitness for purpose and, most importantly, acceptability to the various user pressure groups) and make recommendations to senior management. In earlier times those who made the decisions about computing were computing experts but the major proportion of such committees is now more likely to comprise senior academics and administrators with technical experts offering the policy option evaluations. This shift acknowledges the wider organizational issues involved in the use of computers in universities and also reflects the fact that the majority of computer users, whether they be students or members of the academic, administrative or library staffs, are now much less likely to be experts in computing *per se*.

While such a committee membership would appear to be more representative of users' needs there must always be the concern that they may not have the necessary technical expertise to take decisions with respect to computing policy. It can be argued that the academics and administrators may be unduly influenced by those who have specific computer expertise since they lack the confidence to argue about issues which they may not fully understand. In IT policy planning, as in many

other planning contexts, the policy options are often evaluated by the institution's computer experts before they are offered to the decision makers. The committee's role, in many cases, is merely to monitor and approve decisions. It cannot always be possible for policy makers to challenge the options they are given, owing to the complex nature of the contexts, and in a private communication one senior academic of such a committee has wryly commented that they are there simply to ask the 'common-sense' questions!

To some extent the tendency to act in a mere 'rubber-stamping' capacity must weaken committee approaches to policy planning and in the area of IT, some institutions have moved away from the model of having multi-faceted IT planning committees. Alternatives include vesting the role of IT planning in a senior management group which might comprise the vice-chancellor or principal and the senior officers in charge of the main areas affected i.e. academic affairs, finance and administration. Perhaps a major step in consolidating this process will be taken if the proposals for the JISC are accepted. In these proposals it is expressly stated that the JISC would break from its predecessor's close relationships with the directors of the various university computer centres and instead work directly with institutions' senior management teams (JISC 1992). Another alternative, which is attracting increasing interest, is the creation of a new senior officer post: a 'director of information services' with responsibility for IT policy planning thoughout the institution, i.e. across the academic, MIS, library and infra-structural computing areas.

Once policy is set within an institution, by whatever means, the process of implementation may be inhibited by the next level of tension: when the senior and middle management are required to develop the working practices that the policy implies. Here there often seems to be what might be termed an attitude problem. Anecdotes abound about the ostrich-like reluctance of senior managers and administrators to work 'hands-on' with information systems but to some extent it is a residual effect that is slowly dissipating. In the early days, computing tended to be focused in science, engineering and mathematics departments and in many cases these users had literally to build their own hardware and software tools. As a consequence, computing came to be perceived as requiring a highly technical competence, regardless of its proposed end use, and the legacy of this pioneering period remains to some extent in the psyche if not the practice of many in management and administration. There is still the sense of looking upon IT as a necessary but impenetrable evil which has a following of adherents who seem to revel in a curious jargon. Although the advent of the microcomputer has provided a

platform which offers much greater access and control and has therefore generated a much wider range of users, there remains a real danger that these new users are simply new recruits to the specialist technophile ranks and that IT-literacy beyond this elite is still far from being widely established.

The so-called 'electronic campus' is the ultimate goal of the various developments in information technology in higher education but there are clearly major organizational tensions which hamper its progress, as Nigel Gardner's comments emphasize:

> . . . the problems associated with developing the electronic campus are not ultimately technical, but relate to the new administrative and organizational structures demanded, the social and managerial issues, and the political milieu within which a move to the electronic campus might be implemented. (Gardner, N., 1989, p. 339)

Once the organizational and management issues are resolved there remain the operational tensions.

Operational tensions: implementing policy

The four areas of IT impact: teaching, library administration and automation, MIS and infra-structural computing, have had varying degrees of success in operationalizing their IT integration. Library automation and infra-structural computing have, for example, fared reasonably well in operational development terms in the past decade, perhaps because the problem of 'stock control' (in a library catalogue context) and networking are shared to some extent with the business and industrial sectors. Although the administrative needs of universities are not that dissimilar from those of other large organizations with similar turnovers, the pursuit of efficiencies designed to cut costs and increase profitability (i.e. self-funding sufficiency) are relatively new pressures in the higher education world and until now there has not been the same urgency among administration staffs to espouse high technology solutions. However, in the twin *raisons d'être* of universities – teaching and research – IT integration is very definitely a green field site with nothing similar in terms of the scale, complexity and diversity of these contexts in the private or other public sectors. Aside from international educational influences and trends, developments in the use of IT in teaching and research have had to, and no doubt will continue to come from within the UK higher education community.

Throughout all four areas of potential IT impact one of the major sources of tension must be the implication which rapid technological

change has for hardware and software procurement. And one of the main problems with technological change is '*What machine do we buy right now?*'. The much vaunted open systems policy of many manufacturers and suppliers remains elusive in practice although there is evidence of a general trend in multi-platform portability in software and some agreement on aspects of multi-media technology standards. When it comes to institutional procurement of desktop computers for teaching or administration there are many problems in common:

- **Which model?** Should we wait for the next upgrade of the machine we are considering? If we don't perhaps the machine that is now available will quickly become redundant or, worse still, discontinued.
- **Power?** Should we get machines which are perhaps more powerful than we can currently fully use but which will keep us in good stead as our needs grow in complexity and volume? If we don't will we be able to upgrade the machines we do buy?
- **Which machine?** Should we buy Apple or IBM-compatible machines? Should we buy a mixture and increase the difficulties of providing a maintenance function?
- **Unix?** Should we buy Unix machines now that the market seems to be promoting them as '*the machine to have*' or should we retain compatibility with our current machines? If we buy Unix machines will we be able to have our software transferred?
- **Training?** What will our training overheads be if we buy system X? Whom will we need to train – staff? students?
- **Cost?** Should we buy cheap 'clone' machines from a little known company and hope that they are reliable? If we don't, will we have insufficient budget for the number of machines we really need?
- **Standardization?** Should we buy multi-media products or should we wait a little longer for 'proper' standardization in the market?
- **Accessibility?** Should facilities be centralized or distributed? If distributed should the academic departments undertake to operate and maintain them? Should there be open access centres for all staff and students?
- **How many machines** Should all staff have a personal machine at their desks? Should the Nelson target (1:5 machine:student ratio) be increased (or indeed reached as in the case of many institutions)?

Tensions exist at a variety of levels with strongly held likes, dislikes and opinions; all of which provide for a difficult situation in which the various academic and administrative groups press for their own favourite solution.

If a single-option procurement policy is followed it is inevitable that some groups will cry '*foul!*'. This will be particularly true among the academics whose IT influences, in the same manner as their academic influences, are more likely to come from colleagues in cognate departments in other institutions where other machines might be the norm.

Perhaps more basically, a demand for a major expansion of IT will inevitably raise questions of resource allocation and prioritization. In the face of many competing claims, how much funding will be allocated to resourcing IT for teaching? What will the balance be between the responsibilities of the central management and the subject departments in meeting these resource needs? To ensure a smooth and steady progress in developing the role of IT in teaching and learning, these and similar issues will require clearly thought out and well understood policies to be established and implemented.

In the last decade computing has spread across most disciplines (for examples see Gardner and McBride, 1990; CTISS, 1992; Darby *et al.* 1992) and indeed most aspects of university life. Computers are no longer solely for programmers and the development of 'authoring' tools is now allowing academics to develop their own educational software rather than use software developed by others who may have different teaching objectives or methods. It is worth pointing out, however, that the majority of universities responding to an IUCC survey (IUCC, 1991) disagreed with the view that in the university of the future authoring systems will be used widely by teaching staff. Universities ae being encouraged to back developments in computer-based learning strongly as they look to technology to solve the growing problems associated with teaching ever-increasing numbers of students with no matching increase in staffing. The 250+ bids for Teaching and Learning Technology Programe funding are testimony to this. Nothwithstanding the obvious and burgeoning interest, major problems persist in the implementation of a policy of increasing the use of technology based teaching (for an overview of one university's experience see Gardner, J., 1991 and 1992). Prime among these are the problems which academics experience in finding time for the development of computer-based learning materials while the Information Systems Committee's Courseware Development Working Party (ISC, 1992) has also pointed to the need for career incentives to encourage academics to become involved in the adoption and development of courseware. The need to develop a wider base of 'authoring' expertise is also problematical while the bewildering choice of authoring tools leads to similar problems of support and training to those produced by the variety in hardware choices. Some institutions (e.g. Queen's, Heriot Watt, Leeds and

Bradford) have set up units specifically for the purpose of promoting computer based learning in their teaching provision while the Information Systems Committee Working Party (ISC, 1992) has recommended the establishment of a 'Learning Council' to both monitor and coordinate the development of computer-based learning in higher education and to realize economies of scale in the purchase and dissemination of courseware and courseware development tools. While such a council is probably a non-starter in the current relatively austere climate, the need to optimize and coordinate a broader computer-based learning development in higher education is difficult to ignore.

The relative 'newness' of IT in teaching and learning poses its own curricular problems; there is still a significant degree of debate about the rôle which information technology should actually play in teaching and learning. There is a reasonable consensus that students should, in the course of their studies, acquire skills associated with the particular discipline and any of its professional derivatives (the so-called 'vocational' IT – see Gardner, J., 1992) but there is perhaps less acceptance among academics that the disciplines should contribute to the development of the students' general information technology literacy. Many would prefer to see this 'life-skills' IT (eg. familiarity and competence in general computer processes, in wordprocessing, in the use of databases, spreadsheets and communications and so on) dealt with centrally. Considering the pressing demands on academic time for curricular teaching it is difficult to dismiss the view that any time given over to the training of students in IT literacy would be a relative luxury most academics could not afford. There are grounds, but as yet perhaps little evidence, for expecting that the necessary literacy may be acquired in schools before entry to university so in theory the literacy problem should disappear as the schools' IT provisions bear fruit. In the meantime the development of the 'computer literacy' of graduates is an important aspiration and indeed selling point for universities across all disciplines.

Another issue in IT in teaching and learning is the mode of usage. Little is known about the effectiveness of computer-mediated learning in higher education and still less about the merits of its variants (tutorials, games, simulations, modelling and so on). Some disciplines, particularly those in the humanities, are having to come to terms with unfamiliar teaching environments such as the 'practical' i.e. teaching in a (computer) laboratory context. The collaborative or individualized options for student learning are beginning to attract wider interest in the same manner as other relatively new developments such as self-study, self-assessment and the encouragement of student study-groups.

Much of the impetus for computer-based learning comes from the pressing need to accommodate the rising numbers of students while retaining the quality of the teaching provision, but there is also a growing, largely intuitive belief that information technology, and particularly the increasingly sophisticated multi-media developments, offer real enhancements to teaching quality and breadth.

The future

Predicting future trends in an IT context is a difficult business but it seems certain that technological development will continue for some time at its current hectic pace. The combination of falling prices, increasing processing power, increasing storage capacities and improved miniaturization will form a sound basis for the expected breakthroughs in 'intelligent' interfaces. Communications will shortly take a major step forward with the transmission of not just text but graphics and digitized audi and video on the high speed, fibre optic SuperJANET network. Libraries may yet take quite some time to achieve the 'active intelligent knowledge server' status envisaged by Feigenbaum (1986) but their increasing accessibility, as inter-library networking develops, will make them ripe for the advances in software which will provide them with the necessary 'intelligence'. On the hardware and software front many of the current tensions arising from the diversity and incompatibility of systems will disappear while the increased levels of technical familiarity and expertise among academics, coupled with improved productivity authoring tools, should ensure much more widespread and effective use of computer-mediated teaching. At present, then, it may be argued that the integration of IT in higher education is being hampered by policy tensions and the speed of technological development. Such problems will no doubt persist for some time but there are clear indications that the combination of necessity and professional commitment will, in due course, ensure a wider assimilation and exploitation by academics of the principles and practices of IT in teaching, research and administration.

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