The costs of networked learning: what have we learnt?
A paper presented to the FLISH99 (Flexible Learning on the Information Superhighway) Conference, Sheffield Hallam University, Sheffield, UK, 25-27 May 1999.

Dr Greville Rumble
The Open University

This conference addresses the business case for on-line learning and seeks, within this context, to answer the question: '*Why* are *institutions* across the world investing so much in on-line learning?". Institutional perceptions of the business case for on-line learning will vary, but it will always take account of the costs and benefits of the investment and operating costs.

In this paper I review what is known or at least surmised about the costs of on-line learning; I indicate some of the pitfalls that arise because of current costing methodologies; and I suggest some of the implications that might arise for policy makers, planners, institutions, and learners.

Why is a business case needed?

"Why do we need to make a business case?" Part of the answer has to be the need to legitimise investment. Higher education is already investing very considerable sums in Communications and Information Technology (CIT). In the UK, for example, the Dearing Report estimated that about 10 per cent of the total higher education budget (that is, something between £800 millions and £1 billion, is spent on CIT (NCIHE, 1997). A substantial proportion of this expenditure is has been on the national universities' networks - JANET and SuperJANET. It is here that UK leadership and strategic advantage is seen to lie, rather than in the development of IT products for teaching and learning (Watson and Taylor, 1998: 58). Indeed, the Dearing Committee bought into the view that CIT "holds out much promise for improving the quality, flexibility and effectiveness of higher education" (NCIHE, 1997: paragraph 13.1), without being as whole-heartedly committed to what Webster and Robins called the 'technological fix' - the view that computers and IT will solve the problems of teaching quality and curriculum development in a mass system. Expenditure on technology involves very significant sums - hence the demand for improved investment analysis through Cost Benefit Analysis (Boucher, 1998).

Investment appraisal is part of business decision-making. There is a common assumption that private enterprise invests to increase profits. Where this is not the case, one should leave the money in the bank to earn interest. It is for this reason that the opportunity cost of capital is taken into account in the appraisal of capital-intensive projects. In the public sector, however, where profit is not the motive, Cost Benefit Analysis (CBA) is widely used to appraise investments from a social point of view. CBA thus tries to take account not just of the direct, tangible costs and revenues associated with a project, but also the intangible costs and benefits. This raises problems of measurement and the assignation of value to benefits that, in the case of investment in CIT, are often intangible (e.g. improved student motivation, improved quality of learning experience, improvement in transferable skills, etc.) (Boucher, 1998: 93, 101).

Clearly, making a good investment is a key to business success. Classical decision-making theory assumes that investment appraisal is rational. There is also an assumption that the decision will be based on perfect knowledge of all possible relevant information. This includes reliable projections and forecasts about the future. Experience shows that life is not like this. Further, when one comes to CBA, the problems multiply. Not only can costs be difficult to establish, but the benefits, because so

many are intangible, are difficult both to identify and measure. Not surprisingly, perhaps, as Boucher (1998: 95) admits, the 1996 ITATL (Information Technology-assisted Teaching and Learning) project found it difficult to model the relationship between costs and benefit (see Boucher et al, 1997 on this project).

However, long before anyone began to consider the need for a business case for online learning, there were people who were already investing time and money in it. For many of us the initial investment of time and money in online learning was made without any investment appraisal. This is neither that unusual nor that surprising. Much of what we have been doing in online learning has been in the nature of the experimental and the relatively small-scale. It has been a legitimate research and development activity.

Now, perhaps, times are changing. One could say that we are very much at the stage we were at in the late 1960s in respect of educational technology and particularly educational broadcasting. At that time developments in the use of such technologies had by and large made "surprisingly little progress beyond the handicraft stage" (Coombs, 1968: 7). It was only with the development of large scale capital intensive projects in the Ivory Coast, Brazil, Nicaragua and elsewhere that economists - spurred on by the funding institutions such as the World Bank, UNESCO, and USAID, began to get interested in the cost analysis of educational technology. Perhaps we are at this stage with online teachnologies, where we move beyond the handicraft stage, and where the economics of mass online education suddenly becomes an issue. One reason why we may now be concerned about developing the business case is that there are fears that online learning is not going to deliver the economies of scale that second generation distance education has delivered. We would be a whole lot happier if we could say that there is a business case for the commitment of resource in support of online learning. It would satisfy those who support our efforts financially. It would legitimate our decisions, and show how wise we are to have started along this track.

Given this, it is timely to review what we know about the costs of online learning.

What have we learnt about the costs of online learning?

Currently we know relatively little about the costs of on-line learning. Of course, there may well be organisations that have costed their on-line learning programmes but not released the information. In an increasingly commercial environment cost information is a delicate matter and this might explain why only a few isolated studies of the costs of information and communications technology (ICT) based education have appeared. Indeed, most previous overviews have been severely limited by the absence of hard-cost information.

The 1992 Report of a Working Party set up by the Committee of Scottish University Principals to look into *Teaching and Learning in an expanding Higher Education System* reported that it had yet to be established whether or not computer-based learning could provide volume and efficiency gains (CSUP, 1992: 34). In the same year a DELTA-funded research programme conducted by Tergan and his colleagues (Tergan, 1992: 179) indicated the difficulties of establishing the cost-benefits of computer-based learning systems, and the likely high costs of developing materials for on-line access, They made the point that the benefits of computer-based learning systems should be not be judged just by narrow cost-benefit criteria, but by their pedagogic and psychological benefits. The 1994 *Report on the Costs and Quality in Resource-based Learning On- and Off-campus* prepared for the (Australian) National Board of Employment, Education and Training (NBEET, 1994: 37-8; 40-1) indicated both a

range of approaches and the range of costs involved in delivering electronic courseware. There was little hard cost data from which generalisations could be made. The 1997 HEFCE (Higher Education Funding Council for England) ITATL (Information Technology Assisted Teaching and Learning in Higher Education) undertaken by the Consortium of Telematics for Education team based at the University of Exeter noted the scarcity of literature. They concluded that the few studies that did exist showed little consensus on costing models and an observable variation in cost estimates (Scott, 1997: A3-11). Moreover, the actual case studies undertaken as a part of this study yielded little quantifiable information on either the costs or benefits of ITATL, and much that of the information that was obtained was of variable quality (Boucher, 1998: 95). The most interesting report to date is one produced by Arizona Learning Systems (1998) which looks primarily at the costs of two approaches to distance learning - Two-way Interactive Instructional Television courses, and Internet courses..

So what can we say at this juncture?

All innovations see people starting to identify the cost categories involved. Boucher (1998: 97-8) has identified the cost categories involved in ITATL projects as follows: courseware development costs; incremental capital and recurrent equipment costs; (marginal) costs associated with provision of appropriate resources; infrastructural costs; maintenance costs; user support costs; costs of adoption; access costs; security costs; replacement costs; institutional overheads; spillover costs (i.e. the costs and benefits that accrue to agents other than those originally involved in the decision to undertake an investment); and other miscellaneous costs not covered above. Such categories would need to be matched to the traditional accounting categories of (a) human resources, (b) premises and accommodation, (c) equipment and furniture, and (d) stocks, supplies, consumables and expenses. Other approaches look at the functional underpinning of costs. Such an approach would tend to distinguish between firstly, the costs of developing and maintaining on-line materials; secondly, the costs of on-line activity by learners and those supporting them; and thirdly, the costs of managing the on-line programme. Rumble's study of the costs of computer-mediated communication on an Open University course shows one such approach to the functional categorisation of costs (Rumble, 1989).

A second stage is to identify the likely level of costs involved and their behaviour. This is problematic.

> Because the basic technology is so similar, the materials element of courses delivered on-line may also be delivered in CD-ROM format. However, on-line courses generally incorporate an interactive element which must be delivered via the network.
> On-line materials encompass text, sound, still images (graphics and photos), moving images (video and animation), and computer program-based learning. The range of media involved makes it very difficult to talk about development costs in any meaningful way. *The reported costs of developing on-line learning materials vary widely.* Bates (1995: 197) gave a range of from Canadian $2600 to $21,170 per student-hour for the development of computer-based learning materials. Arizona Learning Systems (1998: 13-14), noting the "many forms that an Internet course may take", cite course development costs of from US$6000 to $1,000,000 for a three unit course, depending on the range of materials presented. Simple outlines and assignments are the cheapest at $6000, followed by text ($12,000), text with reference materials ($18,000), images ($37,500), audio and video ($120,000), simulations ($250,000) and virtual reality ($1 million). Tergan et al (1994: 179) reference French (1990) to the effect that "the production of one hour of standard computer-based teaching necessitates a work input of - conservatively estimated - 150 hours". Sparkes (1984: 219) suggested that it would take 200 + hours to develop computer-aided learning that would occupy a student for one hour. On the other hand, Ravet and Layte (1997: 140-1) argue that while it may cost a great deal to develop the initial programme, the selection and

incorporation of existing tools in CBL (Computer Based Learning) packages will avoid the current tendency to re-invent the wheel every time, and lead to a dramatic reduction in development costs.

The use of *third party copyright* materials is problematic for distance teaching institutions. Rumble (1997: 90-1) reports research to the effect that the break-even point in terms of student numbers at which it becomes cheaper to develop one's own material rather than buy-in someone else's is surprisingly low. Copyright and license fees can be very high. The use of electronic materials incorporating third party copyright materials raises particular problems - so much so that the University of South Australia took the decision not to incorporate such materials into its on-line courses (Moran, 1996).

Many training programmes require the *establishment of training resource centres*. Ravat and Layte (1997: 146) suggested a budget of UK£37,000 to install a networked 15-station resource centre, with recurrent costs of £6000 per year. Universities catering for many several of students face much greater sums. There are also the replacement costs. At Thames Valley University the computers in the University's Learning Resource Centres are replaced every three years. So regular is this replacement that TVU treats computer purchase as a revenue rather than a capital cost. It sets aside an operating budget resourced to replace one third of its Learning Resource Centre computers each year. Mega-universities with many thousands of dispersed students find it too costly to provide students with computers. At the (UK) Open University the costs of computers and of the Internet connection have been passed on to the student. Only a few financially challenged students are given financial support towards their computing costs.

Those supporting students also need access to computers. Most universities regard computers as part of the tools of the trade, and staff are therefore provided with a computer through a variety of means. At the UK Open University this is still true for core staff, but the policy is rapidly moving towards one in which tutors (of which there are some 7000) will be responsible for providing themselves with their own "tools". Given the rate of obsolescence in the face of rising course specifications, this will be a significant and more or less regular renewal cost for OU tutors.

Ravet and Layte (1997: 143-2) point to the very significant overall savings that accrue from training on-line, compared to face-to-face training. The savings come from reducing the costs of the time and travel spent in attending courses. Phelps et al (1991: 12-14) showed that while the conversion to computer-mediated communication format of a two-week residential course for US Army reservists involved additional staffing costs of US$152,300, and start-up costs of $73,100, the running costs came down from $289,650 to $121,300. They concluded that the CMC version would have been about 20 per cent more costly if it only substituted for one presentation of the residential course, but if it substituted for ten presentations, then total costs were halved. Even more significant were the savings gained when British Telecomm used a CD-ROM to train its operators in the use of computerised telephone exchanges. The cost of this was 6 million ecus, against an estimated cost of 60 million ecus had traditional training methods been used (Van der Brande, 1993: 112).

Where interactive student support is provided on-line through e-mail, computer conferencing, etc., there are the up-front costs of creating a virtual campus, and the recurrent costs of running it. Rumble (1989), in an early study of the costs of supporting computer mediated communication on an Open University course with 1364 students and 65 tutors, identified development costs of UK£1.54 million, with annual running costs of £368,000 across all stake-holders (students, tutors, University, special Government development grant) (1989 price levels). Annualising and

discounting the development costs resulted in an annual cost of £646,000, and a per student cost of £474. This course was, however, the first to use computing extensively, and some of the costs were incurred in developing the University's home-based computing policy. If only the costs attributable to the course were taken into account, then the per student cost fell to £136, of which the University bore £114 per student, the students £20 each, and the tutors £3 per student. Some of the Open University's development costs arose from customising the conferencing system (CoSy) it was using. Such costs would be avoided if only commercially available software was used. Edith Cowan University spent Australian $500,000 in 1993 to install the basic hardware and software, with the direct per student cost reckoned to be about A$150 of which $50 is for support to the service and $100 is to meet the students' on-line costs (NBEET, 1994: 78). Staffing costs to support the service came to another A$130,000 in 1994. The number of students and tutors supported on the virtual campus in 1993 was, however, only 170 and 25 respectively.

Both the early Open University and the Edith Cowan University schemes sought to meet some of the *students' costs.* Current arguments favour the transfer of costs from the State to the student, and as computers become an acceptable consumer item, so one can expect the trend to require students to provide their own computers to accelerate.

In the Open University students had to meet their own connection charges. In 1989 these averaged out at £1.95 an hour. On average students connected for about 9 hours (Rumble, 1989). At Edith Cowan University, the University sought to meet students' on-line connection charges. However, some institutions that started out supporting the costs of students' connection have found the cost of doing so too great. Muzio (1992) describes the Certificate Programme in Computer Based Information Systems offered by the University of Victoria in Canada. Initially students were connected to the University's mainframe computer via a modem and BC Telephone's DATAPAC system. This gave them access to the University's electronic mail system. The system cost the University C$128 per student (at 1989 price levels). Students were charged C$50 for the service. The University quickly changed the system so that students linked into a bulletin board. The latter cost the University C$350 per year, with the students paying their own telephone costs to access the system.

In distance education, *whenever materials substitute for face-to-face support, savings accrue*. As the authors of the NBEET study put it:

> "The question of possible savings arising from up-front investment in the preparation of materials is best addressed by focusing on the nature and extent of the support provided to students while they are using the materials. The theoretical prediction is that there should be economies of scale arising from up-front investment in high cost study materials. ... the question of possible savings hangs on the question of what level of student support is to be considered acceptable." (NBEET, 1994: 157)

The great advantage of on-line systems is that they can support individualised, constructivist models of teaching and learning, and thus overcome the inherent depersonalisation and standardisation of first generation (correspondence education) and second generation (multi-media models). However, this is a labour-intensive activity. The cost structure of on-line distance education is thus nearer face-to-face models than first- and second-generation models with their economies of scale. The biggest and I suggest the least costed ingredient in the costs of on-line learning is the cost of supporting learners on-line. Tutors at the Open University consistently suggest that they are spending more time supporting learners on-line than was the case when they

> supported them through correspondence and telephone contact. They are not being paid for this increased workload. The University has been talking about protocols to curb student demands on their tutors. At one level this reflects a process of change from an industrialised distance learning system in which students were expected to study more or less independently with relatively little direct support from a tutor, to a more supportive environment. The costs of this shift are unclear. Working out of Athabasca University in Canada, however, Annand (in press) suggests that it is these costs that may in the end constrain the extent to which large scale distance teaching universities can adopt on-line technologies. Arizona Learning Systems (1998: 20) report that "All providers of Internet courses ... have reported that this direct communication [between teachers and students] takes more time than preparation and delivery of a classroom lecture and the corresponding contact with students. The time estimates have ranged from 30 minutes per student per week to 4 hours per student per week". In some cases colleges have restricted course enrolments in order to bring instructor time down (ibid., 22).

What then are the direct and average costs of on-line learning? There is very little date as yet. Arizona Learning Systems (1998: 7) report that faculty workload costs have pushed the typical direct cost per course enrolment of an Internet course (US$571) above that of traditional classroom instruction ($474), but they suggest that faculty workload will be reduced through improved support and processes. They project that measures such as the development of academic helpdesks could result in unit costs falling to $447. With fixed costs amortised over an (in my view optimistic) five years, they suggest that the fully allocated (i.e. average) cost per course enrolment should fall as enrolments rise. For a simple text course unit costs would fall from $782 per enrolment with 10 students to $453 with 500 enrolments; on a multi-media course with images, the cost per enrolment would be $1496 with 10 students, falling to $467 with 500 students (ibid., 24).

Why are we worried about the costs of on-line learning?

Most of the people in this room will be looking for opportunities to invest in on-line learning, and to identify the strengths that flow from that investment; and they will be trying to identify the weaknesses that will arise, and hence the threats, from a failure to invest in on-line learning.

Let me therefore make one thing clear. I do not think that there is an absolute need to justify on-line learning in cost terms. There are many more important justificatory reasons for on-line provision - to do with the alleged increased pedagogic effectiveness and better quality of student learning, or because one can reach new kinds of people and new overseas markets, or satisfy new kinds of consumer demands. Many of these outcomes are very difficult to quantify and give a value to. However, what is important to realise is that *even if* on-line learning is more expensive than other approaches to teaching and learning, we might still want to use it. Cost is only one element in the equation.

On the other hand, as Ursula Franklin, a leading Canadian scientist, wisely observed:

> "Whenever someone talks to you about the benefits and costs of a particular project, don't ask 'What benefits?', ask *'Whose* benefits and *whose* costs?'. At times it helps to rephrase an observation in line with a perspective from the receiving end of technology." (Franklin, 1992: 124).

It seems clear that investment in the development of on-line materials involves changes in costs and

cost structures. In the mid 1990s, opinion seemed divided on what the result of these changes might be. Optimists such as Tiffin and Rajasingham (1995: 166) argue that "the virtual class scenario makes economies of scale possible. There are no limits to the size of virtual lecture theatres, no costs for building, maintenance, cleaning, lighting and ventilating, virtual class spaces". Against this, however, there are "the costs of an interface device so that teachers and learners can access virtual classes". However, the unit costs of such systems depend on scale, and economies of scale are there to be reaped: "As long as the numbers of people using virtual classes are small the costs will be high, but when millions of students around the world are using the technology, the costs per capita will be low" (ibid.: 166).

Others are more cautious. Collis (1996), reviewing the development of tele-learning, points to the substantial cost of setting up a home-based tele-learning environment (p. 139), the problems of funding the installation of the necessary infrastructure in schools, and of meeting the costs of accessing network resources, particularly the Internet (pp. 266-7, 373-5). Collis (1996: 375) cites Moonen (1994) to the effect that "to reduce costs in the long run, some costs must be shifted to the student. Students must take more responsibility for learning themselves, and expect less personal contact from instructors". So not only do students have to be more independent; they also have to take on board more of the costs of accessing education. This shift of costs onto the student raises concerns about the ability of socio-economically deprived sectors of the population to participate in on-line learning.

So why might we be worried about the costs of on-line learning? There are a number of reasons. Here are some:

a fear that the overall cost will be too great for our institutions.
a fear that the costs imposed on students will be too heavy for them, and that this will impact adversely on other agendas (for example, that of widening participation).
to identify costs with a view to understanding and controlling them.
to identify costs as an element in setting prices.
to demonstrate increased cost efficiency.
to demonstrate increased cost effectiveness.
to justify projects in terms of their costs and benefits.

These objectives are more easily stated than achieved. Costing is not a precise art, and traditional cost systems and management reporting methods are deeply flawed, with the result that information on the costs of products and services is often seriously inaccurate (Johnson and Kaplan, 1987; Rumble, 1998). Investment appraisal and capital budgeting is also problematic. Hayes, Wheelwright and Clark (1988) are particular trenchant in their criticisms of capital budgeting. Over-reliance on quantifiable measures of cost leaves out of the reckoning all those important non-quantifiable, subjective, qualitative judgements. Of course, one can give these aspects a weighting, thus dragging them into a cost-benefit equation - but the very act of weighting non-quantifiable benefits involves subjective judgements. Added to this, the forecasting and planning considerations built into capital investment appraisal "usually defy analytical treatment" (Makridakis, 1990: 132) . In the end capital budgeting - like all other kinds of budgeting - is as much about political processes as anything else. Project proposers use capital budgeting procedures to get a foot in the door - to get some initial capital investment upon which they can build in the future by pushing for incremental growth (Mintzberg, 1994: 129). Top managers know this is going on: they tend to approve projects coming up from people they trust. Turning down a project is in effect saying you have no confidence in the proposer (ibid.: 126). But thank goodness top management acts like this. As Quinn (1980: 174) puts it, "If key players

had acted on the rational financial information available at the time, there would have been no xerography, no metal skis, no aircraft, no jet engines, no television, no computers .... and so on *ad infinitum*".

References

Annand, D. (in press) "The problem of computer conferencing for distance-based universities", *Open Learning*, article in press.

Arizona Learning Systems (1998) *Preliminary cost methodology for distance learning*. Report dated August 21, 1998. Arizona Learning Systems and the State Board of Directors for Community Colleges of Arizona.

Bates. A. W. (1995) *Technology, Open Learning and Distance Education*, London, Routledge.

Boucher, A. (1998) Information Technology-based Teaching and Learning in Higher Education: a view of the economic issues", *Journal of Information Technology for Teacher Education*, 7 (1), 87-111.

Boucher, A., Davis, N., Dillon, P., Hobbs, P. and Teale, P. (1997) *Information Technology Assisted Teaching and Learning in Higher Education*, Bristol, Higher Education Funding Council for England.

Collis, B. (1996) *Tele-learning in a digital world. The future of distance learning*, London, International Thompson Computer Press.

Committee of Scottish University Principals (1992) *Teaching and Learning in an expanding Higher Education System: Report of a Working Party of the Committee of Scottish University Principals*, Edinburgh, CSUP.

Coombs, P. H. (1968) *The world educational crisis: A systems analysis*, Oxford, Oxford University Press.

Franklin, U. (1992) *The real world of technology*, Concord, Ontario, House of Anani Press Ltd.

French, P. D. (1990) "A domain-independent student mode for an AI-based training system", *Computer Education* 15 (1-3), 49-61.

Hayes, R. H., Wheelwright, S. C., and Clark, K. B. (1988) *Dynamic manufacturing*, New York, Free Press.

Johnson, H. T. and Kaplan, R. S. (1987) *Relevance lost. The rise and fall of management accounting*, Boston, Harvard Business School Press.

Makridakis, S. (1990) *Forecasting, planning and strategy for the 21st century*, New York, Free Press.

Mintzberg, H. (1994) The rise and fall of strategic planning, Hemel Hempstead, Prentice Hall International (UK) Ltd

Moonen, J.(1994) "How to do more with less?", in Beattie, K., McNaught, C. and Wills, S. (eds.) (1994) *Interactive multimedia in university education. Designing for change in teaching and learning*, Amsterdam, Elsevier.

Moran, L. (1996) *Distance education, copyright and communication in the Information Society*, Report prepared for UNESCO meeting of the Committee of Experts on Copyright in the Information Society, New Delhi, India, November 1996.

Muzio, J. (1992) "Distance-taught computer education for managers and professionals at the University of Victoria", in Rumble, G. and Oliveira, J. (eds.) (1992) *Vocational education at a distance: International perspectives*, London, Kogan Page.

NBEET (National Board of Employment, Education and Training) (1994) *Report on the Costs and Quality in Resource-based Learning On- and Off-campus*, NBEET Commissioned Report No. 33, Canberra, Australian Government Publishing Service.

NCIHE (National Committee of Inquiry into Higher Education (1997) *Higher Education in the Learning Society* (The Dearing Report), London, Her Majesty's Stationery Office.

Quinn, J. B. (1980) *Strategies for change: Logical incrementalism*, Homewood, Irwin.

Phelps, R. H., Wells, R. A., Ashworth, Jr., R. L., and Hahn, H. A. (1991) "Effectiveness and costs of distance education using computer-mediated communications", *The American Journal of Distance Education*, 5 (3), 7-19.

Ravet, S. and Layte, M. (1997) *Technology-based training. A comprehensive guide to choosing, implementing, managing and developing new technologies in training*, London, Kogan Page.

Rumble, G. (1989) "On-line costs: Interactivity at a price", in Mason, R. and Kaye, A. (eds.) (1989) *Mindweave: Communication, computers and distance education*, Oxford, Pergamon Press.

Rumble, G. (1997) *The costs and economics of open and distance learning*, London, Kogan Page.

Rumble, G. (1998) *The costs and economics of p[en and distance learning: methodological and policy issues*, PhD Thesis, The Open University, Milton Keynes, July 1998.

Scott, P. (1997) "The economic costs and benefits of Information Technology assisted teaching and learning in higher education", in Boucher, A., Davis, N., Dillon, P., Hobbs, P. and Teale, P. (1997) *Information Technology Assisted Teaching and Learning in Higher Education*, Bristol, Higher Education Funding Council for England.

Sparkes, J. J. (1984) "Pedagogic differences between media", in Bates, A. W. (ed.) (1984) *The role of technology in distance education*, London, Croom Helm.

Tergan, S-O, Hron, A., Mandl, H. with Hartge, T. and Schneider, B. (1992) "Computer-based systems for Open Learning: State of the Art", in Dimmer, G and Blume, D. (eds.) (1992) *Open Learning and Distance Education with Computer Support*, Nurnberg, BW Bildung und Wissen, Verlag und Software GmbH.

Tiffin, J. and Rajasingham, L. (1995) *In search of the virtual class*, London, Routledge.

Van der Brande, L. (1993) *Flexible and distance learning*, Chichester, John Wiley.

Watson, D. and Taylor, R. (1998) *Lifelong learning and the university: A post-Dearing agenda*, London, The Falmer Press.

Webster, F. and Robins, K. (1989) *The technical fix: Education, computers and industry*, London, Macmillan