

Virtual University – Real Challenges: Infrastructure and Faculty Support at De Montfort University

Professor Stephen Brown
De Montfort University, UK

Abstract

Innovations frequently fade away because they are not taken on board by the organisation as a whole and the individuals associated with them move on to other activities. In an increasingly borderless environment, on-line open learning seems an obvious survival strategy for many institutions threatened with increasing competition and mounting costs against a backdrop of reduced resources. Yet large-scale change in delivery and support methods entails high degrees of risk for traditional institutions because scarce resources have to be redirected to new activities, thus potentially weakening traditional activities. This paper reviews the De Montfort University attempt to exploit the properties of on-line technologies to enhance the quality of traditional provision through mixed mode delivery. The Electronic Campus initiative was set up as an organisational change project, led from the top but intended to encourage local ownership. In two years the Electronic Campus has developed around 200 on-line modules which have been studied by 3000 students. Student responses have been favourable and despite initial reservation, staff involved have generally reported favourably on its impact on their teaching and students. Nevertheless, this initiative has had only limited impact in terms of its benefits to the organisation as a whole. This is because, in order to minimise risk, in its initial phase it was established as a distinct project with management and development processes separate from, and parallel to, the normal structures and processes of the university. This paper reviews the lessons to be learned and describes a strategy for scaling up and transforming this localised initiative into 'business as usual' by embedding it into established mainstream activities, based on published models of organisational change

Change and adaptability

“The capacity to cope with change will be the hallmark of success in the 21st Century”
(Extract from The Learning Age, UK Government Green Paper on Lifelong Learning HMSO 1998)

There is a growing belief that learning is a key to economic success and competitiveness, whether at the level of a company, an individual, or the state. Knowledge is rapidly outdated in a fast changing world, employees need to enhance their attractiveness through periodic self development and employers need to update the skills of their workforce in order to remain competitive (BCC 1998) (IoM 1998). Notwithstanding local labour shortages, overall the labour market has tightened in the face of a developing surplus of people combined with a declining number of jobs (DfEE 1998a).

The appearance of corporate universities such as Unipart 'U' (<http://www.unipart.co.uk/97report/ugc97.htm>) and the British Aerospace Virtual University (<http://www.bae.co.uk/furniture/indinfo.htm>) are corporate manifestations of these concerns and of a growing sense that industry needs are not being adequately met by traditional education and training providers. Recent UK initiatives such as the proposed University for Industry (DfEE 1998b) and Lifelong Learning reflect similar concerns at Government level.

At the same time change is being driven from within as traditional models for mass higher education based on behavioural theories give way to more learner centred and resource based philosophies (Hardy 1997). This change in philosophy reflects wider changes in society since the 1960s away from authoritarianism towards individualism and the emergence of a customer oriented culture and constitutes a major paradigm shift within education.

Learner centred approaches seek to accommodate individual learner needs and acknowledge that learners may have other calls on their time. This leads to more flexible delivery and support strategies which allow learners to shift the time, place and pace of learning. Rigid classroom timetables and

enrolment schedules become more relaxed, allowing for multiple delivery of the same curricula at different places at different times. The role of the teacher shifts away from that of expert instructor to learning facilitator. Involvement of the learner in the development of the learning experience necessarily requires the 'teacher expert' to relinquish control and allow others (learners) to contribute (Laurillard 1993). The rapid development of digital, networked multimedia technology such as the Internet, email and computer based and video conferencing assist with this process and at the same time open up opportunities for learners to seek out and utilise learning resources offered by other parties.

Globalisation and Competition

In the UK, per capita spending on HE students declined by 20 per cent between 1991/2 and 1996/7 (THES 1998), stimulating greater competition between universities for resources. Competition is not just local. UK Higher Education providers are facing increased competition in traditional overseas markets as well, where countries such as the USA and Australia are vigorously recruiting students whom might have otherwise studied in the UK. Furthermore many overseas governments are seeking to expand and enhance their local provision instead of sending such large proportions of undergraduates to study abroad, e.g. India, Singapore, Hong Kong, Indonesia, South Africa.

Universities are also facing the threat of competition in their own back yards as universities with global aspirations begin to emerge and commercial companies take an interest education (Daniel 1997, Middlehurst et al 2000), motivated by the enormous revenue potential of a market worth US\$256.6 Billion in the US alone in 1999. Distance education enrollments are expected to rise from 750,000 in 1998 to 2 million by 2002, the world 'E-Learning' Market will be worth US\$46 Billion by 2005 and 6.6 million adults (age 25 or older) are expected to enroll by 2007. (Zastrocky 2000). From the UK perspective the recent appearance of 'virtual', 'on line' universities such as Western Governors' University (www.wgu.edu) and Colorado University's CU Online (www.cuonline.edu), with their potential to deliver globally, are cause for concern.

Commercial organisations such as Phoenix University (www.uophx.edu/online), or ZD University (www.zdu.com) operating in the same way are further indications of the possible shape of things to come. Other commercial providers include News International's Worldwide Learning Ltd., Jones International University (www.jonesinternational.edu), the Pearson group's FT Knowledge and Addison Wesley Longman in Australia (also part of Pearson). It has been estimated that private education is growing 20,000 per cent faster than public education (Tapscott 1999).

Another threat comes from corporations such as Qantas Airlines, South Africa Telecom, Unipart, British Aerospace, MacDonalds, IBM, PeopleSoft, Disney, Motorola, and Daimler Benz which offer in-house training through their own 'Corporate University'. In 1990 there were about 500 corporate universities in the USA. By 1998 there were more than 2,500 (Snider and Sorensen 1999). Motorola has taken the next logical step and opened up internal staff training to the public, estimating that over 20 per cent of its 100,000 students come from outside the company (Gladieux and Swail 1999).

Re-inventing the University

All of the above factors are driving Universities to reconsider their roles and methods. What is clear is that new ways have to be found of carrying out at least some of the functions of traditional universities and that overall new ways of doing things will have to cost less than traditional methods. In the absence of significant sums of new money to effect change, the task facing universities today is how best to re-engineer the resources already at their disposal to deliver and support the changes needed.

Many traditional HE institutions are seeking to create some kind of on-line presence. While some universities have sufficient resources to mount their own commercial Virtual University presence, e.g. Melbourne University Private Ltd (<http://www.muprivate.edu.au>), NYU Online (<http://www.nyu.edu/virtual>), California Virtual University (<http://www.california.edu>) or the University of Texas (<http://www.utsystem.edu>) most are unable or unwilling to take the risk of mounting an effective opposition on their own. Instead individual institutions are forming consortia or partnerships to create sufficient critical mass and to spread the risk. These are formed either among themselves, e.g. Eurospace 2000, a consortium of 45 European universities; or with complementary organisations such as the 'Fathom' consortium led by Columbia University and including Cambridge University Press, the British Library, the Smithsonian Institution's National Museum of Natural

History and the New York Public Library; or with commercial partners e.g. The London School of Economics' partnership with Pearson Group's FT Knowledge or the link between Universitas 21, an international consortium of 18 elite research universities, and News International.

Forbes magazine in the US has published a guide to the 'top 20 Cyber-Us', compiled by Ebeling and Bistayi (1997). Philips and Yager (1998) published a guide to virtual university study opportunities profiling 195 accredited universities offering over 1000 distance learning courses. By 1998 the United States Department of Education estimated that 1,680 institutions in the US offered around 54,000 online courses (THES 2000) and the International Distance Learning Course Finder, launched in May 2000 claims a directory of over 50,000 courses from 65 countries (<http://www.dlcoursefinder.com>).

However, when one takes a closer look at the reality of virtual university provision to date it is interesting to note how much of it depends on older technologies including books, video, and residential periods on campus as well as videoconferencing. (Hawkrigge 1998, Farrell 1999).

There appear to be a number of good reasons why established, traditional Higher Education providers should hold back from large-scale conversion to on-line delivery. These include: the high costs of courseware development; the longer development timescale and relative inflexibility of resource based learning compared with face to face classes; shortages of appropriate ICT infrastructure; staff concerns about the impact of new technologies on their own jobs and on the quality of the student learning experience; and management concerns about the possible consequences of failure if large scale investments do not deliver the required competitive advantage. Also, traditional universities have strengths that are, by definition, missing from cyberspace: physical locations that provide a respite from the everyday demands of home and work; facilities and equipment that are not readily simulated in virtual space; people with whom to socialise, enjoy physical contact, chance encounters, etc.

The Electronic Campus

Faced with this dilemma, De Montfort University in the UK has opted for a hybrid model: The Electronic Campus. The Electronic Campus is an Internet based addition to the face to face delivery and support systems of the university that is intended to enhance flexibility of access to learning *on campus*. This is not therefore a move into the arena of distance learning so much as an attempt to exploit the properties of on-line technologies to enhance the quality of traditional provision through mixed mode delivery.

The first phase of this initiative established a centrally managed, university wide project, providing students in all faculties and at all levels of study with access to World Wide Web based learning materials and email and conferencing learning support systems (Brown 1998). During its first two years of operation, over 3000 students studied via the Electronic Campus.

The Electronic Campus can be seen to have a number of precursors which have been important in terms of preparation and rehearsal for the major event itself. De Montfort is a distributed university with 10 campuses spread over central, eastern England, over 100 miles (160km) between its farthest points. The intention behind the distributed university model is to offer, as far as possible, equality of learning opportunities across and between different campuses. This creates special challenges for the organisation in terms of learning delivery and support. Widespread bussing of staff or students to different campuses is not a viable option economically, even if it were educationally. Alternative ways have had to be found to provide students with comprehensive, consistent and quality learning experiences regardless of their locus of study and over the last four years the university has launched a variety of related, but independent, localised and uncoordinated, projects covering:

- Videoconferencing.
- Computer Mediated Communications.
- Computer Marked Assessments.
- Digital Library developments.
- Computer based learning, including CD ROM and World Wide Web.

Although these initiatives individually provided more flexible access and support for learning and teaching across the university, they did not form part of a single coherent strategy; they did not have a single owner. Consequently there were at times incompatibilities and even conflicts between the

different projects which limited their impact. The intention behind the establishment of the Electronic Campus was to integrate at the institutional level previously disparate strands of activity in order to ensure a maximum and rapid return on investment of resources. To achieve this, 5 key policy decisions were taken at the start of the project which set the parameters for Electronic Campus developments:

1. Single delivery medium: the World Wide Web.
2. Software standards for authoring, assessment and conferencing.
3. Local project management and determination.
4. Central funding and project monitoring.
5. Central support for local project development.

Delivery via the World Wide Web was chosen because it offered the possibility of a virtually universal delivery capability. From this followed priorities for infrastructure investment, software tools and staff development. It was necessary to introduce software standards for development and delivery to reduce costs and maximise the potential for exchange and integration between different projects, although some flexibility has been retained to allow for variations in needs and to avoid dependence on a single product or supplier. Readily available, easy to use, development tools were important to ensure maximum take-up by teaching staff and to allow training courses to be made available easily and cheaply. Faculties have been encouraged to develop and manage their own project proposals based on local requirements, however funding for the initiative has been made available centrally to encourage take-up. Central funding has also made it easier to track expenditure, buy in resources, such as software site licences, at the institutional level, and to ensure that agreed project targets are met. Project budgets have been controlled centrally, releasing funds against agreed milestones. Care has been taken to ensure that central support for Electronic Campus activities makes it as easy as possible for teaching staff to become involved. Each Faculty has been allocated a specific, individual, Learning Development Manager (LDM) who is a member of a central curriculum design and production team with educational technology and curriculum development and delivery expertise. LDMs work with Faculty colleagues to:

- Develop appropriate teaching, learning and assessment strategies.
- Develop teaching and learning proposals for internal and external funding.
- Identify and obtain resource based learning materials produced elsewhere.
- Provide a link through to central design and production resources.
- Develop and implement learning support strategies and systems.
- Identify and meet staff development needs in relation to implementation of the Electronic Campus.

In most cases projects have been based on resources already developed in the university and in areas most likely to have maximum impact on students and staff. The learning activities modelled include lectures, seminars, tutorials, practical assignments and cognitive assessments. Materials produced include pdf documents, straight HTML pages, web interfaced databases, including image databanks, and on-line assessment exercises, plus on-line computer conferencing, videoconferencing, FAQs, e-mail and synchronous 'chat'. Projects underway will generate video and audio files as well. In addition to these in-house projects, the University has been actively embedding into the curriculum learning resources which have been developed at other institutions under the auspices of the UK Teaching and Learning Technology Programme (Scott *et al*, 1998).

Evaluation is an essential part of the development and introduction of any educational innovation (Laurillard 1993) and a variety of formative and summative instruments have been employed to gather useful data including student pre module questionnaires to capture student profile data, attitudes and expectations, post module questionnaires and focus groups to gather feedback and module assignment scores to obtain objective measures of performance. Staff have also been interviewed to ascertain their expectations and actual experiences of developing, delivering and supporting on line learning and teaching. Early formative findings were fed back into the development process while summative results have been collated to provide an overall picture of the impact of the Electronic Campus initiative.

The overall impression created by these findings is that generally students were positively disposed towards electronic learning. They had positive expectations in advance and they subsequently reported that their experiences had been positive in terms of accessibility, ease of use, interest and quality. This is not to say that there were not negative comments and findings. For example some modules tended to use the WWW essentially as a publishing medium without addressing its interactive potential (a common problem, Farrell 1999) resulting in the perception that the material was not particularly

interesting or valuable. Another finding to emerge was that when the material was designed to be interactive, many students do not have the necessary skills to use it effectively. Computer logs and follow up interviews revealed that many found it difficult to manage their time effectively when offered a more autonomous learning environment, stripped of the reminders found informally in a face to face teaching context (Brown and Cruickshank 1999).

On the whole, staff were less favourably disposed initially, voicing reservations about the use of ICT similar to those reported elsewhere (Brown 1997, Littlejohn and Stefani 1999), including inadequate skills and lack of understanding of pedagogical role. As staff became more involved their initial fears were displaced by concerns about the amount of time required for development (Brown et al in press) and the costs of reviewing, licensing, modification, distribution and installation of software packages produced elsewhere (Scott *et al*, 1998). Nevertheless, on balance, the teaching staff involved have been enthusiastic about the impact on their teaching (Brown and Cruickshank 1999, Brown et al 2000).

Critical success factors have included:

1. Pump priming the innovation to make it easy for Faculty staff to get involved and for resource managers to sanction their involvement. Also to make available additional central resources beneficial to the innovation, e.g. Software site licences for software packages adopted as standards.
2. Maintaining central control over project budgets has enabled close monitoring of expenditure against agreed schedules and deliverables.
3. Location of projects within Faculties has ensured local relevance and ownership and hence commitment and enthusiasm.
4. Establishing Learning Development Managers to work with specific Faculties has developed stronger links between the central support services and Faculties and encouraged a culture of innovation and creativity.
5. Focussing on HTML as the primary medium for delivery and support has helped to simplify the decision making and development process. The choice of medium sets priorities for infrastructure investment, software tools and staff development and defines useful parameters for functionality.
6. Concentrating on unsophisticated, readily available, development tools, such as Microsoft products, ensures that all staff have easy access to them and where necessary, training courses can be made available easily and cheaply.

(Brown, S. 1999)

Limits to growth

While these factors have helped the Electronic Campus to achieve some quick gains, longer term they are in danger of imposing limits to further growth. The development of virtual teaching institutions is still experimental (Farell 1999) and hence risky. In its initial phase the Electronic Campus was established as a distinct project with management and development processes separate from and parallel to the normal structures and processes of the university in order to minimise risk to the institution as a whole. This inevitably limits the impact of the initiative across the university; it increases costs through duplication of functions and processes and imposes limits to its expansion and continuation. Innovations of this kind frequently fade away because they are not taken on board by the whole organisation and the individuals associated with them move on to other activities (Brown 1997). So, having transformed electronic delivery and learning support from a raft of localised, uncoordinated, separate initiatives into a single co-ordinated programme, the next challenge is to convert it to 'business as usual' by embedding it in established mainstream activities.

Five key areas have been identified for future action:

1. Staff rewards
2. Staff skills
3. Curriculum development
4. Strategic development planning
5. Integration

Staff Rewards

University institutional structures do not encourage efforts to change and improve teaching (Albright and Graff 1992). However, it has been possible to put in place a number of incentives to encourage involvement in Electronic Campus developments. In practice 78% of the project money allocated to Faculties has been used to buy out staff time to release staff from other duties, particularly teaching. Money is not enough however to ensure adequate human resources. In our experience the Faculty staff taking a lead in Electronic Campus have typically been heavily committed to other key activities as well, such as student recruitment, research, university consultancy, administration, etc. It has been difficult therefore for such people to allocate as much time to Electronic Campus projects as they themselves would like (Brown et al 2000). Other, complementary, changes need to be put in place not only to facilitate but to actually reward contributions. The University has now set up a Teacher Fellowship scheme and enhanced the promotion system to formally recognise and reward innovation and excellence in teaching. Teacher Fellows have the same academic status as Readers but their role is to encourage good practice in learning and teaching and act as champions for change. They are appointed for 5 years and given a development fund to facilitate new learning and teaching initiatives within their faculty, to disseminate ideas and to support colleagues in developing their teaching roles.

Staff skills

Institutions developing on-line teaching commonly pay little attention to the importance of staff retraining and development (Farrell 1999). Yet HE staff have limited conception of how to use the WWW effectively for teaching and Learning (Thomas et al 1998). In an interactive on-line learning environment the role of the teacher changes from provider of knowledge to facilitator of learning (Jonassen 1996, Desforges 1997) working with students to help them create adapt and refine their knowledge and understanding. Primarily there seems to be a lack of vision of technology as an integral part of the curriculum, resulting in C&IT activities being bolted on to the curriculum rather than thoughtfully included in ways which fully consider pedagogical parameters. (Littlejohn and Stefani 1999). A new department within the Division of Learning Development, the Centre for Learning and Teaching (CLT) has been created to both lead and support this aspect of organisational change. The University has increased its investment in professional development via this centre which, in the first instance, is funding faculty staff release and development activities to facilitate the development of strategic development plans which will in turn identify further staff development requirements arising from the introduction of new learning and teaching methods and technologies. Individual module and course proposals are required to quantify the development needs of all staff involved in their design, delivery and support.

Curriculum development

University Quality Assurance procedures have been rewritten to ensure that proposals for Electronic Campus modules are no longer considered separately. The proposal and approval procedures have been incorporated into the standard procedures for approving and validating new or revised modules and responsibility for funding is now devolved to the faculties. This is aimed at moving the E-Campus development process into the mainstream processes of the university, embedding it into 'business as usual'.

Strategic development plans

As part of this embedding process, faculties are being helped to develop, resource and implement an annual strategic development plan for learning and teaching as part of their overall annual business plan. This plan should be based on a vision for the faculty in the year 2005, integrating teaching, research and revenue generation goals in the context of the university strategic plan which, *inter alia*, stresses the importance of flexibility of provision and the key role of new technologies. However, this is not a technology push solution. Faculties are free to develop their own strategies best suited to their own requirements, within certain defined constraints such as the need for increased flexibility and resource limitations of various kinds. These constraints create boundaries around hypothetical solution spaces within which faculties can position their responses in terms of the student profile they intend to target, the range of course provision they want to make, the teaching methods they will employ and the kind of learning modes they will support. In turn, all of these issues have implications for resourcing plans extending beyond the immediate learning and teaching resource requirements of equipment including staff and student development needs and infrastructure plans and including central university functions e.g. networking, catering, security, estate management, etc. Central support teams have been created to help faculties with the development of their strategic plans, drawing on staff from functional

areas of the university concerned with Staff Development, Libraries, Quality Assurance, FE provision and Learning Technologies.

Integration

The final strand in the embedding strategy is to link up the E-Campus materials with other on-line resources to create an integrated learning support environment. Known as the 'Virtual Desk', it brings together a variety of learning resource and support tools into a single, **personalised**, learning environment, including on-line modules, assessments, timetables, conferencing and email systems, individual performance records and contact information, plus access to a wide range of generic student support services selected to support effective learning in the widest sense. These include library resources, Internet search tools, a browsable database of all the university's modules, examination papers, and other student information services. In so doing it places the student at the centre of the university information support services. See <http://english.iielr.dmu.ac.uk/Desk/index.shtml> for a prototype version.

(figure 1 about here)

On the administrative side, the newly implemented Student Data System (SDS) will bring together electronically all student data from first enquiry to final progression. The University has been extensively evaluating the possible use of Smart Cards and authentication technologies such as LDAP for the provision of a single sign-on system. The University is issuing smart cards to new students in September 2000 and wants to give value-added services to the student using the card in the near future. DMU aims to develop a secure single login system within the next two years that will provide access to learning and teaching material. Both the University's Information Systems strategy and the financial year 1999/2000 Information Systems capital programme reference projects to integrate data into a single desktop environment as well as providing student access to personal information.

From the student perspective, the Virtual Desk will combine access to their personal learning resources, academic support, and student records (such as personal details and fee information). This aligns, on the one hand, with wider shifts in DMU learning and teaching towards integrated mentoring and key skills support services; and on the other, with enabling the student to access different information systems in a seamless manner.

Reflections on the De Montfort Experience

The Electronic Campus project has been successful up to a point. A significant amount of material has been developed or converted for Web delivery and effective on-line support systems have been implemented. Staff are initially cautious about on-line teaching, but once engaged become enthusiastically committed to the point where the amount of time spent greatly exceeds that devoted to development and delivery of face to face teaching. Notwithstanding some minority views and experiences, overall students are positively predisposed towards electronic and network-based learning and their expectation are largely met and in some cases surpassed by the reality of on-line learning. More objectively there has been no significant difference in student assessment results for those working on Electronic Campus modules, compared with peers studying traditionally or compared with previous cohorts on the same modules. The down side of this successful approach has been the marginalisation of Electronic Campus activity as a result of the policy decision to keep it separate from mainstream university processes. A successful strategy will address both content and the process of obtaining commitment (Daniel 1996). The tentative conclusion here is that a ring fenced project is a good strategy to establish rapid results and momentum (Carey et al 1999) but that in the longer term it can have only limited impact.

Migration from face to face teaching methods to more flexible, hybrid, face-to-face/on-line learning delivery and support is more than just a technical challenge; it requires a culture change, which is much harder to achieve, particularly in the democratic environment of a university. Bottom up approaches tend to founder on the rocks of competing policies and priorities of concern to different parts of the institution. On the other hand, a top down, management led, approach can be frustrated at the level of middle management where hard choices have to be made about resource allocations in the face of strong competing pressures. The following recommendations are based on our experiences so far:

1. In the initial phase of introduction the innovation is best set up as a distinct project in order to minimise risk to the institution. This implies some duplication of effort, for example approvals procedures. For it to become business as usual it is essential to embed it in the normal processes of the university
2. Ensure there is a champion for change in teaching and learning at the highest levels of leadership within the organisation, and an unbroken chain of responsibility for teaching and learning developments down through the hierarchy to the grass roots.
3. Ensure that there are clear, well publicised, mission statements regarding teaching and learning development goals at university level.
4. Establish procedures for producing and implementing strategic learning and teaching development plans, including measurable targets, which address resource requirements and monitor performance against these plans.
5. Allocate each Faculty a dedicated "learning development manager" from the central team to work with them to advise on solutions and assist with proposal and materials development, staff development, evaluation and liaison with the central team.
6. Establish and publicise reward systems, for example, explicitly recognise successful leadership of innovative learning projects in criteria for promotion; reward involvement in such projects with periods of study leave; provide staff with teaching relief to enable personal and materials development; offer financial rewards for development of quality learning resources.
7. Enhance staff development opportunities with identified budgets and set up development activities which assist staff to develop and enhance their resource development and learning facilitation skills.
8. Organise events to take the initiative to the staff.
9. Establish central funds to encourage faculty-based activity and establish central project selection and monitoring procedures and central control of budgets.
10. Create development teams in which individuals focus on their specialist contributions to the collective effort.
11. Gather evaluation data and publicise the results.

References

Albright, M. J., D.L. (eds.) (1992) 'Teaching in the information age: the role of electronic technology'. *New Directions for Teaching and Learning Series* No. 51, San Francisco: Jossey Bass.

BCC (1998) *Small Firms Survey: Skills*. London, British Chamber of Commerce.

Brown S. (1997) *Open and Distance Learning: Case Studies from Industry and Education*. London, Kogan Page.

Brown, S. (1998) 'Re-inventing the University'. *ALT-J Association for Learning Technology Journal*. 6 (3), 30-37.

Brown, S. (1999) 'Virtual University: Real Challenges'. Proceedings of *ED-MEDIA 1999, AACE 11th Annual World Conference on Educational Media, Hypermedia and Telecommunications*, pp 759-764. Seattle, Washington, USA, 19-24 June 1999. CD ROM.

Brown, S. Cruickshank, I. (1999) The Digital Darkroom: an investigation of the impact of virtual courseware on pedagogy and people in the field of applied photography. Presentation for RUFIS'99 (Role of Universities in the Future Information Society) October 21-24, 1999 Northern Arizona University, Flagstaff, Arizona U.S.A.,

Brown, S, Hardaker, C., & Higgett, N. 2000 'Designs on the Web: A Case Study of On-line Learning for Design Students.' *ALT-J Association for Learning Technology Journal*. Vol. 8, No. 1, pp 30-40.

Carey, T., Harrigan, K., Palmer, A., Swallow, J. (1999) 'Scaling up a learning technology strategy: supporting student/faculty teams in learner-centred design'. *ALT-J Association for Learning Technology Journal*, 7 (2), 15-26.

Daniel, J. (1997), *Mega-Universities and the Knowledge Media: Technology Strategies for Higher Education*, London: Kogan Page.

Desforges, C. (1997) 'A theory of complex learning', *Perspectives* 56, 17-22.

DfEE (1998a) *Skills Shortages: An initial Survey of Evidence*. London, Department for Education and Employment.

DfEE 1998b *University for Industry: Engaging People in Learning for Life. Pathfinder Prospectus* London, Department for Education and Employment.

Ebeling, A. and Bistayi, S. (1997) *Wired Degrees: Forbes' 20 top Cyber-Us*
<http://www.forbes.com/forbes/97/0616/5912084a.htm>

Farrell, G. M. (ed.) (1999) *The Development of Virtual Education: A Global Perspective*, Commonwealth of Learning.

Gladieux, L.E. and Swail, W.S. (1999) *The Virtual University & Educational Opportunity: Issues of Equity and Access for the Next Generation*. Washington, D.C.: The College Board,
<http://www.collegeboard.org>

Hardy, D.W. (1997) 'Instructional design for distance education', *Open Praxis*, 1, 26-29.

Hawkrigde D. (1998) 'Cost-effective support for university students learning via the Web?' *Association for Learning Technology Journal* 6, 3, 24-29.

HMSO (1998) *The Learning Age: A Renaissance for a New Britain*, UK Government Green Paper on Lifelong Learning, London: HMSO Cmnd 3790.

IoM (1998) *UK Corporate Employment Strategies and Trends 1997/8*. London, Institute of Management

Jonnassen, D. H. (1996) *Computers in the Classroom: Mindtools for Critical Thinking*, Englewood Cliffs, NJ: Merrill, Prentice Hall.

Laurillard, D. (1993). *Rethinking University Teaching: A framework for the effective use of educational technology*. London: Routledge.

Middlehurst, R. et al (2000) 'The Business of Borderless Education: UK Perspectives.' *Committee of Vice Chancellors and College Principals* Report POL23.

Philips, V. and Yager, C (1998) *Best Distance Learning Graduate Schools: Earning Your Degree Without Leaving Home*, Princeton review/Random House. See also
<http://www.geteducated.com/bestgrad.htm>

Scott, B., Ravat, H., Ryan, S., Patel, D. (1998) Embedding TLTP and other resource based learning materials into the curriculum. *Active Learning*, 8, 1-4.

Snider, J.C. and Sorensen, A.A., (1999) 'Technology offers opportunities for global quality in education' *Open Praxis* 2, 11-12.

Tapscott, D. (1999) 'Don Tapscott on the Future of Education'. *The NODE: Networking* June 1999. <http://www.node.on.ca/networking/june1999/feature.htm>

THES 1998 'Spending sword with two edges', *The Times Higher Education Supplement* May 29 1998, 6.

THES (2000) World Watch *Times Higher Education Supplement* 21 January, 11.

Thomas, P.J., Carswell, L., Petre, M., Proce, B. A. 1998 A holistic approach to supporting distance learning using the internet: transformation, not translation, *British Journal of Educational Technology*, 29 (2) 149-61.

Zastrocky, M. (2000) 'Distributed Learning and The New Competition in Higher Education'. Presentation for *UCISA 2000 Management Conference*, 15-17 March 2000, Scottish Exhibition & Conference Centre, Glasgow. <http://www.ucisa.ac.uk/calendar/Ann-Conf-Program2000.html>

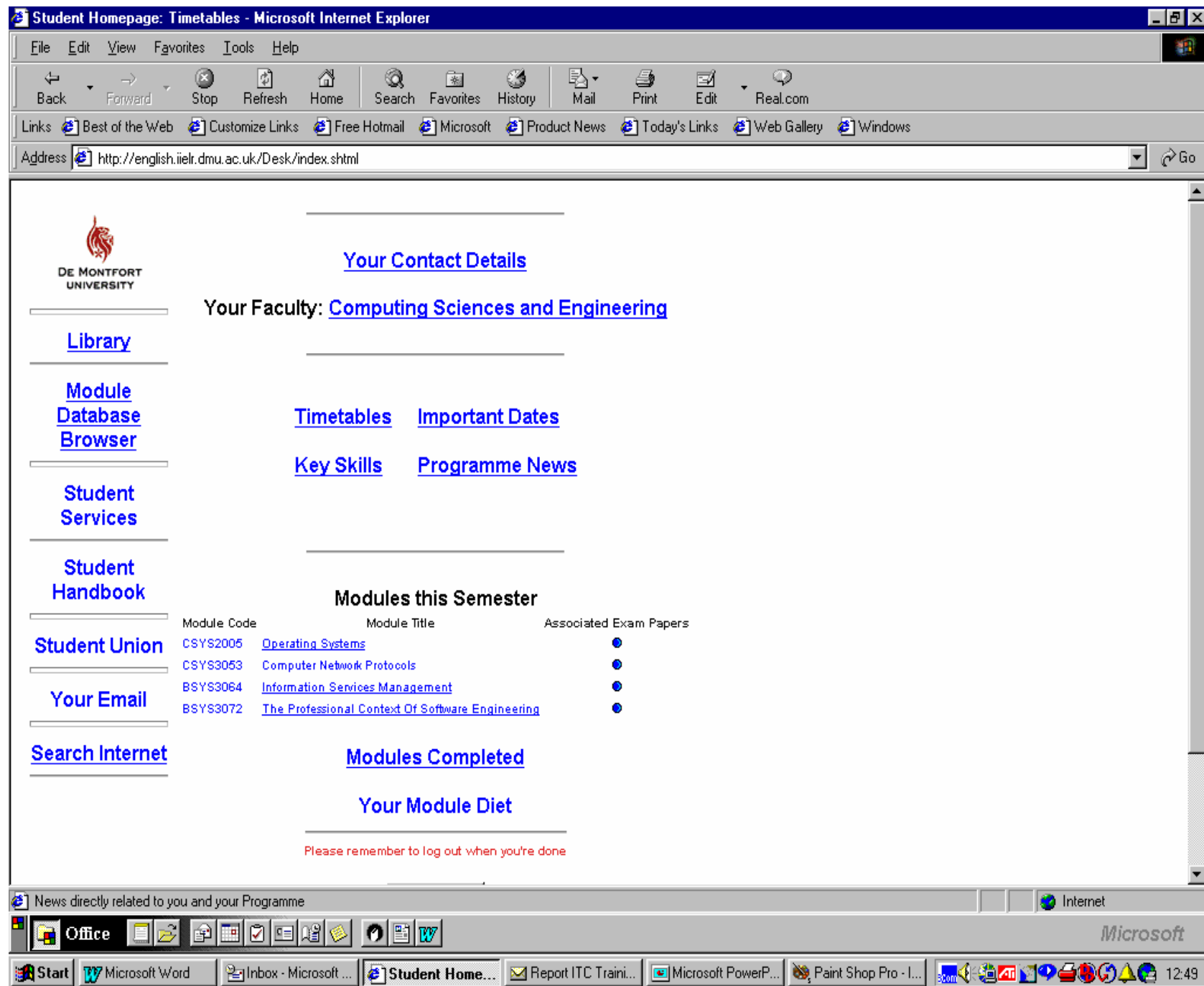


Figure 1. Prototype 'virtual desk'