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ABSTRACT

This report describes the role of the Open University (OU) in providing technologically innovative opportunities in adult and continuing education in Britain. An introductory section explains the purpose of the Open University; its history and principles; its programs of study; its teaching methods and media; technology in its teaching system (print, broadcasting, audiocassettes, videocassettes, computers, videodiscs, and satellites); its costs; and external recognition of the open university system. A second part presents two case studies illustrating how the OU teaches about technology at the undergraduate and professional levels. In the first example, course components (applications areas, technical and social "tributaries," role of the television programs, and policy for home computing) are explained. The second example offers a description of a series of 12 short practical courses aimed at updating professional engineers in the manufacturing industry. The paper concludes with a discussion of key factors in developing an open university: (1) the need for a relatively large number of students to justify the large initial cost of designing quality distance teaching materials; (2) the apparent fact that quality costs money; (3) the need for working in conjunction with industry and government; (4) the importance of designing a complete system for open learning; and (5) the need for consistent and high-level political support for open universities. (14 references) (CGD)

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CREATING A TECHNOLOGICALLY INNOVATIVE CLIMATE:

THE BRITISH OPEN UNIVERSITY EXPERIENCE

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Introduction

The Open University is an important agent in Britain for creating a technologically innovative environment. It does this in at least three ways:

(a) by creating courses which encourage innovation: these courses not only influence specific target groups, but through their method of dissemination, these courses also bring to the attention of the general public important technological developments

(b) by using teaching methods and media which are themselves technologically innovative, influencing not only the students who study in this way, but also the educational world at large

(c) by itself being a system which is designed to be innovative, adaptive, and productive.

General description of the Open University

History and basic principles

The Open University was created by a Socialist government, under the leadership of Harold Wilson, in 1969, and took its first students in 1971. The first Vice-Chancellor, Walter Perry (1976) identified three main influences which led to the establishment of the Open University:

(a) the growing demand for adult and continuing education

(b) the growing awareness of the potential of broadcasting for university-level education

(c) a strong political commitment to equalising educational opportunities for university-level education in Britain.

In 1969 (as now) access to higher education opportunities in Britain was highly restricted. Only 8% of an age-group went on to University, and only 15% of an age-group went on to any form of higher education. The Open University was created to give an opportunity to all those that wanted a higher education a chance to study, in their own time, in their own homes, without having to leave

their jobs or their families. Thus the University has an open-access policy; no formal qualifications are necessary in order to register as an Open University student. The University accepted 25,000 students in its first intake; then as now there were almost twice as many applicants as places. The University operates on a "first-come-first-served" principle, with some attempt to balance numbers across the different regions. Students study primarily at home, in their own time.

Courses

The Open University offers three programmes of study:

(a) The *Undergraduate* programme, which involves study over a number of years, typically five or six, and leads to the degree of Bachelor of Arts or further to a BA with honours. At present there are more than 130 undergraduate courses, across six faculties: Arts, Social Sciences, Maths, Science, Technology and the School of Education. Many courses are inter-disciplinary and are jointly produced by more than one faculty. In any one year, about 20,000 new students register for the foundation courses (although the number of applicants in 1986 was 56,000), and the total of registered undergraduate students in any one year is 65,000 (this limit is set by the government). Just over 50% of any year's intake will go on to graduate eventually (roughly 6,000 per year). Altogether, 76,000 students have now acquired a BA, of which 10,000 have carried on to acquire honours. The undergraduate programme is largely financed by the government through a direct grant to the University, but 15% of the cost of a full credit course is payed by the student. The student fee for a full credit course in 1986 is £152.

(b) The *continuing education* programme, which offers a variety of single courses, both on academic subjects and vocational up-dating and professional training, as well as self-contained learning packages and short courses on matters of everyday concern. At present there are more than 200 packs and courses, including 115 courses from the undergraduate programme which can be studied singly. Altogether, the total of packs or courses bought in the CE programme in 1986 was over 179,000. Continuing education courses are self-financing, either from student fees or from sponsoring funds. Short study packs (covering perhaps just four weeks' study), may cost students as little as £8, while longer courses may cost anywhere between £120 to £435. Courses may be booked for groups as well as individuals, and used for in-house

training by a company.

(c) The *higher degrees* programme, which provides limited opportunities for both taught and research-based postgraduate study leading to a higher degree (B.Phil., M.Phil , and Ph.D.). In 1986 there are 1,100 higher degree students. Altogether, 400 higher degrees have been awarded.

Students need six credits for a general degree, and eight for an honours, of which at least two credits must be at an advanced level. A credit is roughly 400 hours study, spread out over 32 weeks, from February to October. Many courses are half-credits, i.e. 16 weeks study spread over 32 weeks. A course then might have 16 or 32 *units*, each unit representing one week's study of approximately 12 hours in total. Students are assessed both continuously, through tutor marked assignments (roughly one a month), and by a supervised examination at the end of the course.

Teaching methods and media

The main medium of teaching is through specially prepared correspondence *texts*, supported by *broadcast television, audio-cassettes*, and some *radio*. On the larger courses, and especially at foundation level, local *face-to-face tutorials* are provided, either as evening classes, or Saturday day schools. Attendance is optional. On smaller courses, where students are more scattered or remote, *telephone tutorials*, including *audio-conferencing* , are sometimes provided. Each foundation course, and most of the science and technology courses, have one-week residential *summer schools*, and some science and technology courses have specially designed *home experiment kits*.

The courses are prepared by teams of academics, employed full-time on tenure by the Open University. Also on the teams are educational technologists, who advise on course design, television/radio/audio producers from the BBC, editors, and a course administrator. Sometimes external consultants are also hired, where specialist subject expertise is lacking. In the undergraduate programme, it usually takes at least two years of design before the course is first presented, then the course will normally run for at least eight years For a foundation course, this may mean nearly 50,000 students following the same course over the eight years. The headquarters at Milton Keynes employs 2,600 full-time staff, of whom 442 are academics.

The teaching is supported by an extensive regional provision. There are 13 regions, each with its

own full-time administrators, responsible for recruiting and monitoring the 5,000 part-time tutors and counsellors, organising the 253 study centres located usually in other educational establishments, and the local summer schools located in conventional universities, providing advice to applicants, organising examinations, and increasingly liaising with industry and other educational institutions in the area. Approximately 600 full-time staff are employed in the regions.

Technology in the Open University's teaching system

Print. Print is the core of Open University study materials. The Open University is the largest educational publisher in Britain, in terms of the new titles created. It mails out over 2 million publications each year to students. The texts are used not only by Open University students, but since they are also marketed through bookshops, are frequently bought by students and teachers in conventional universities. The Open University has been using rather traditional methods of print production, with academics producing drafts typed by secretaries, then handed over to editors and graphic artists, who lay out the material and pass it on to commercial publishers, for typesetting and then printing when proofs have been checked. The University now though is looking at electronic publishing. It should eventually be possible for all text preparation and editing to be done electronically, with the final version printed via laser technology.

Broadcasting. The Open University has a unique partnership with the BBC. When the University was established in 1969, the BBC agreed to commit staff and facilities to the production and transmission of up to 300 television and radio programmes per annum. To do this, it set up a separate department, BBC/Open University Productions (BBC/OUP). The University, through its grant from the Department of Education and Science (DES), pays the total cost of all BBC activities associated with the production and transmission of Open University programmes. In recent years, the DES has funded a £5.5 million modern, purpose built broadcast production facility on the University campus, which is managed by the BBC on behalf of the University. BBC/OUP employs about 400 full-time staff. In 1986, it produced approximately 160 television and 300 audio programmes for the Open University, which used approximately 22 hours a week on the BBC's national television networks, and about 6 hours a week on radio, for its programmes. The Open University payed the BBC £9.5 million in 1986 for production and transmission of its programmes. Provision of broadcasting varies from course to course. The maximum a student will receive is one 25 minute TV programme a week (on most foundation and science courses), although most courses have at least some television and audio support. On average, students will watch about 60% of the television programmes on any particular course.

While the numbers of students actually registered on a course viewing programmes may be relatively small by broadcasting standards, the numbers watching from the general public may be as high as 400,000 to 800,000 for a single programme broadcast at 11.30 pm or on a Saturday or Sunday morning. BBC/Open University television programmes therefore have important roles in both providing a serious educational alternative to entertainment programming, and bringing the world of science, technology, culture and learning to the public at large. In this way, they help to bring technological innovation to the attention of the general public, perhaps in a more informed and thoughtful way than general broadcasting and newspapers.

Audio-cassettes. The audio-cassette is a good example of the value of low-cost technology in distance education. Up to 1979, the BBC was producing about 300 radio programmes a year for the Open University. However, radio was never highly valued by the majority of Open University students, partly because the BBC allocated Open University radio programmes to particularly unsociable times, such as 6.00 am. Consequently, the University started to produce audio-cassettes, as nearly all students have audio-cassette players. The University is now distributing over 750,000 audio-cassettes a year to students, while radio production has dropped to around 70 programmes a year. Audio-cassettes are very cheap to make and distribute (a C60 can be copied and delivered to a student for less than 50 pence). It is cheaper to send audio-cassettes to students (which they keep) than pay even the marginal cost of radio transmission, for courses with up to 1,000 students per year. Students can use audio-cassettes when they need to, and can stop and start them to obtain mastery learning. Most cassettes are not lectures, but are tightly integrated with the printed texts, talking students through diagrams, illustrations, statistics, or providing discussion material for analysis. Audio-cassettes are a highly cost-effective [illegible] are not public, like radio programmes.

Video-cassettes. While there is a similar move towards using video-cassettes, this trend is developing much more slowly than for audio cassettes. In 1986, about half the homes in Britain have a video-cassette machine. While this figure is high, the University is concerned about students without such machines, and the cost of acquiring one. Also, video cassettes are more expensive to distribute than audio-cassettes. Consequently, video-cassette distribution is limited to [illegible] courses with small student populations, and broadcasting is still the main form of distributing television at the Open University.

Computers. Since its early days, the Open University has provided computer [illegible] courses

Students originally were dependent on access to terminals in the main study centres, linked by telephone to two or three mainframe computers. More recently, home experiment kits have been used to provide students with a micro-processor, for understanding both computer hardware and programming. The University is now developing a home computing policy, which will require students on certain courses to have a micro-computer at home. The implications of this for the dissemination of information about technological innovation will be looked at more closely later in the article.

Video-discs. The Open University has made a computer-controlled video-disc for use at summer school, but until video-disc players are available in most homes, they are not likely to be an important technology for most distance education courses, although for industrial training they are becoming increasingly significant.

Satellites. At the moment, the Open University is not making use of satellite technology, but it sees satellites as an important development in the next few years, not only as a means of making available its undergraduate courses to students in Europe, but also as a means of extending its work with industry and commerce in the field of professional and technological training. Perhaps of all the new technologies, satellites offers most to the European community with regard to creating a suitable climate for technological innovation, a point I will return to later.

It can be seen then the Open University itself depends heavily on technology for its teaching, and at the same time is having to respond itself to rapid technological change.

Costs

The provision of high quality distance education at university level to large numbers does not come cheap. In 1986, the Open University's income over the year for the undergraduate programme was £71 million.

It should be noted that this does not include the cost of the Continuing Education programme, which is meant to be self-financing. Each year, the Continuing Education programme brings in another £6.2 million from student fees, course sponsorship, sales of packs, and grants for courses from various government agencies. The Continuing Education programme though is indirectly subsidised, in that it makes additional use of facilities already provided for the undergraduate programme. Thus the majority of the Continuing Education television programmes are charged at

marginal cost, i.e. the cost of making one more programme, but excluding capital overheads, which are already payed for through the undergraduate programme.

Income and expenditure are made up as follows:

	Income (£)	%		Expenditure (£)	%
Grant from DES	60,799,000	84	Faculties (inc research)	15,900,000	22
Fee income	10,370,000	15	Operations	9,230,000	13
Other income	450,000	1	Regions	16,200,000	23
			BBC	9,500,000	13
			Central administration	9,644,000	13
			Estates/facilities	5,774,000	08
			Student hardship support	1,053,000	01
			Staff reductions	1,900,000	02
			Other expenditure	2,418,000	03
Total	71,619,000	100		71,619,000	100

External recognition

The Open University places great store on its external recognition. It is important that the Open University's degree is seen as being at least as valuable as a degree from any other British university. The Open University has the same legal status as all other universities in Britain. It has a Charter issued by the Queen in Council. It also has the same academic conditions of service as other universities. Academic staff have time and facilities for doing research, as well as teaching. The Open University also has a rigorous system of external assessment of its teaching materials. Each course has a course assessor from another university, and most units also have independent assessors. Each examining board for each course has an external examiner from another university. Staff from other universities are also used as part-time and summer school tutors. The Open University's teaching is public. The programmes are seen on national television and the texts are available in local bookshops. Students who obtain credits in an approved combination of courses are recognised for membership of professional societies. Increasingly, other universities are accepting OU credits. Lastly, research on Open University graduates suggests that employers are increasingly recognising the value of an Open University degree for purposes of recruitment,

internal promotion, and salary increases (e.g. see Woodley, 1986).

Teaching about technology: two case-studies

The Open University is more and more developing courses aimed at increasing the awareness and ability of the public with regard to new technology. It does this by means of introductory courses for people with no previous background in using the newer technologies, and through the provision of advanced courses for already qualified professionals, who wish to up-date themselves with regard to new technological developments which will directly affect their work. Such courses may be targeted at individuals, or at companies.

DT200: An Introduction to Information Technology

This course, currently in its planning stages, is due for first presentation in February,1988. It is a full credit course (32 weeks), and is part of the undergraduate programme. Students will already have done at least one foundation course, probably either Social Sciences or Technology, or maybe even both. It is an inter-faculty course, which looks at both technological and social issues arising from the application of information technology (computers and related communications technologies) in society. It assumes no previous knowledge in the subject area. It is anticipated that over 2,000 students a year will enrol for this course.

The course has a complex structure. There are several components: the main applications areas, a technical tributary, a social tributary, 12 television programmes, audio-cassettes, a specially prepared set book containing selected readings, and a set of practical activities, based around a home micro-computer which students on this course will require.

The applications areas. The course is divided into six blocks. After the introductory block, which identifies a number of general themes for the course, the second block looks at the applications of information technology in the home. The third block looks at banking and retail applications, and the fourth block at applications in education and training. The fifth block is concerned with industrial applications and the last block looks at government policy and applications.

The technical tributary. This explains how the technology works, including the basic scientific principles, and discusses some of the major technological issues arising from using information technology.

The social tributary. This looks at the main social issues arising from the applications of information technology. It looks at questions of ownership, access and control, and the underlying philosophies which determine the speed and way in which information technology is introduced.

The television programmes. These have two main functions. One is to help explain some of the technical issues; the other is to present actual case-studies of the application of information technology, bringing out both the underlying technological and social issues. Thus there are TV case-studies of the French viewdata system 'Teletel', the use of information technology in bank training and for large-scale manufacturing, and the use of satellites for rural development in India.

The home computer. The Open University has developed a policy for home computing. For five years from 1988, courses are expected to standardise around one common machine specification, to enable students to move from course to course without having to change machines. DT200 will be one of the first courses to be designed around this provision. The machine will have 500k memory, a black and white monitor, MS/DOS operating system (i.e. IBM compatible), disk-drive and printer, at a price to the student of around £300. On this particular course, the University will also provide a modem, allowing the student to link up through the telephone system to the Open University's own mainframe computer. Students and tutors will use British Telecom's public packet switch system, which will enable most students to use local call rates for on-line access to the mainframe computer. The average cost of off-peak connection will be less than 50 pence an hour.

The course starts by showing students how to use their micro for word-processing and communications. Students will use their micro for communicating with their tutors and other students. It will be used as a mail service between students and tutors. Students will be able to prepare messages on their home micro, and will then send them to "mailboxes" on the mainframe computer. When a tutor or student next connects up, he or she will see a message telling them they have mail, and will be able to read the mail delivered to their mailbox. Instead of waiting several days for a response, the response can be received much more quickly. We are planning for at least one tutor-marked assignment to be submitted and marked electronically. Secondly, the system will be used to set up conferences on particular topics to which all students and tutors can contribute. Thus there will be an electronic "coffee lounge", open to all students and tutors, where anyone can join in and follow the comments made to date, then add their own, on the topic being discussed. There will be a staff "common room", where only tutors and central academic staff will be able to

communicate. This can be used for clarifying points about the course, suggestions for marking schemes for essays, or general criticism of the course. Thirdly, the system will be used to allow students to access large data-bases. Thus we hope students will have access to the PRESTEL Education data-base, and to a massive government data base listing all adult education courses in Britain.

On this particular course, the university is using the technology to teach students about the technology. In particular, it aims at giving them confidence and developing the necessary skills to make full use of the technology themselves, as well as questioning and thinking about the wider social implications about the use of new technologies.

Short practical courses for manufacturing industry

As part of the Continuing Education programme, the University has devised a series of 12 short practical courses aimed at up-dating professional engineers in the manufacturing industry. Four of the courses are concerned primarily with industrial applications of computers, and another eight courses concerned with new materials, processes and systems in manufacturing. Eight of the courses involve approximately 100 hours of study, and the other four 50 hours of study. Each course can be studied separately, or if students satisfactorily complete a total of 800 hours they will be awarded a postgraduate diploma. With the successful completion of an approved project, a student can convert the diploma to an M.Sc. degree.

These courses have been funded by the Science and Engineering Research Council. Students can either enrol as individuals, or companies and organisations may sponsor employees or block book packages for several employees if they wish. The courses are a mixture of specially written texts, video-cassettes, and practical work. The practical work centres around a microprocessor (called HEKTOR III), designed at the Open University which can be used in three modes: it can be used as a terminal connected via a modem and telephone lines to the Open University's mainframe computing system; as a stand-alone computer, on which students can develop their own programming and run specially chosen applications packages; or, for two courses on robotics, as a robot controller. For these two courses, a specially designed industrial robot arm is provided with the course materials. For the 100 hour courses, fees are between £260 and £365 for each course. In addition, five of the 12 courses require the use of HEKTOR III, which costs £285 to purchase (although it can be shared if used within a group booking), and the robot arm can be hired for £250 for a five month period. These courses provide professional engineers with the opportunity to

up-date themselves, either at home or at work. Over 1,000 students have enrolled for these courses in the last 12 months.

These are just two examples of the flexible way in which an open university can help adults adjust to technological change. It should be noted that both these teaching initiatives go beyond merely *talking* about technological change and innovation, they also provide students with the *skills* and the *opportunity* to participate in, manage and control such changes.

The Continuing Education programme in particular is responding flexibly and quickly to the need to provide professional development and training in a rapidly changing technological world. Because the programme has to be self-financing, it is quick to respond to government and industrial initiatives. In general, courses are developed much more quickly in the Continuing Education programme, frequently buying in external subject expertise, but drawing on the University's own staff and facilities to structure and design distance learning materials. The undergraduate programme is more concerned with laying down solid foundations for learning, and has to deal with a very heterogeneous audience, many of whom will not have studied since leaving school. Their courses therefore follow a more or less similar design and mix of media. There is much more variety though in the Continuing Education programme, matching course design to specific needs. For instance, in order to disseminate quickly the latest state of the art in artificial intelligence to a wide technical audience with no prior knowledge in the field, the Alvey IKBS Awareness Programme commissioned the Open University to video-record a set of lectures by distinguished experts in the field, to be used as a stimulus to seminars, training courses, scientific congresses and private study.

One of the most successful Continuing Education areas is the Open Business School, providing a wide range of courses which will eventually lead to a Masters Degree in Business Administration. Another initiative is contract training, whereby a company contracts the Open University to convert or design training materials for independent study at distributed sites.

Key factors in developing an open university

There are now about 20 open universities around the world, some, like the Sukhothaithammithirat Open University in Thailand, with much larger numbers of students than the British Open University. There is enough experience to make some broad generalisations about criteria for success.

The first factor seems to be the need for relatively large numbers of students to justify the large initial cost of designing quality distance teaching materials. This in turn requires a high level of funding, at least to get the institution successfully started. Open universities in fact display all the economic characteristics of large-scale manufacturing, where high initial investment and high volume of output leads to low marginal costs. For instance, the British Open University could take many more undergraduate students at low marginal cost; indeed the marginal cost of taking an extra student is almost covered by that student's fee. Once established, open universities can be very cost-effective. For instance, the cost to the taxpayer for teaching an Open University graduate is about one third that for a conventional university graduate, in addition, most Open University students are working full time, and therefore contributing to national productivity

Secondly, it is apparent that quality costs money. Few other open universities have the range and mix of media found at the British Open University. In particular, few use broadcasting or even video-cassettes, and quite a number have no or minimal local tutorial support. However, not only is the quality of Open University materials highly regarded, the drop-out rate compares favourably with conventional education. Over 75% of registered students successfully pass their foundation course, and the average number successfully completing higher level courses is about two-thirds. Television and computers provide a much broader basis for study, providing practical work and examples, encouraging students to apply what they have learned to their own, real-world situations.

Furthermore, the public nature of broadcasting, and the high quality of the printed materials, brings science and technology to the attention of a much wider public than just those enrolled on Open University courses. This is one reason why satellites are likely to be so important for education and training, because they are able to bring educational and training materials to a much wider range of people, on a continental basis. This will be of particular interest to multi-national companies. There is a tremendous need in industry and commerce for on-going training and professional development. IBM alone spends $1 billion on training in Europe, and more flexible and effective methods than traditional residential courses or evening classes are required. Open universities, working in conjunction with industry and government, are one way in which *high quality* training and professional development can be provided at reasonable cost.

Thirdly, the importance of designing a complete system for open learning is increasingly apparent. An alternative to open universities is the university extension model, whereby conventional

universities are also responsible for off-campus teaching. This model is particularly prevalent in Sweden, the United States, and Australia However, open learning at a university level is struggling in all these countries. The extension programmes are dominated by the conservatism of traditional academics. Research and on-campus teaching receives priority over extension work. Consequently, the range of courses available to working adults off-campus tends to be less, with a heavy emphasis on traditional academic subjects. The same prior qualifications as on-campus students are usually required, despite the greater experience of more mature students, and the off-campus teaching material is less well prepared than by open universities, and media other than print, face-to-face teaching and occasionally telephone teaching is rare. Often, attendance at classes is compulsory, and it is impossible to complete a full degree through open learning methods. One glance at the Open University budget will show how different it is to a conventional university. Less than a quarter of its budget goes to the faculties, whereas nearly a half goes to regional services and administration. Purpose-built open universities encourage team work, multi-disciplinarity, and innovative course design, given adequate resources.

The last element is perhaps the most crucial: open universities need consistent and high-level political support. Governments have to fight for them. It is no co-incidence that the Open University is directly funded by government, separate from the funds for the other 46 conventional universities. Political support for the Open University, from all parties, has been good.

Open universities are not cheap options for governments. They are though a valuable and solid means by which a technologically innovative climate can be created.

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