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ABSTRACT

This paper provides an overview of new technologies likely to be widely available within the next 10 years for teaching in Europe. It begins by presenting a framework which draws distinctions between different technologies based on their educational applications, i.e., for teaching or operational purposes, for communicating within or between systems, or for various levels, types of courses, or users. Evaluation criteria such as availability, organizational environment, and educational and operational rationales are also discussed. The following technologies are then discussed: (1) electronic publishing; (2) audiovisual media, including terrestrial broadcast television and radio, videocassettes, satellite, cable, and videodiscs; and (3) computer technology, including teaching about computers, computers as study tools, educational communications, administration, pre-programmed computer-based learning, and artificial intelligence It is suggested that home-based learning, center- or work-based learning, and communications within and between systems are likely to dominate distance education during the next 10 years. It is concluded that technological decisions need to be preceded by policy and educational decisions, while recognizing at the same time that the availability of new technology allows for major changes in distance education. (8 references) (MES)

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TECHNOLOGY FOR DISTANCE EDUCATION: A 10 YEAR PROSPECTIVE

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Introduction

We are living through an exciting time regarding technological developments of relevance to distance education. There is, to say the least, a lot happening: artificial intelligence, compact discs, electronic publishing, home computers, satellites, video-discs, to name but a few. What is the potential for these and other technological developments for distance education? Perhaps even more importantly, what steps should European distance teaching institutions take to ensure that the 'right' media are chosen, and what needs to be done to ensure that appropriate technologies are not only chosen, but are properly harnessed and used to increase the effectiveness of distance education in Europe?

This paper attempts to provide an overview of new technologies likely to be widely available for distance teaching in Europe within a 10 year time-frame, attempts to look at the decision-making and organisational requirements necessary to ensure that technology is properly used, and also looks at the implications of technological developments for European-wide co-operation and delivery of distance teaching materials.

Gazing into the crystal ball: past experience

Any attempt to look into the future is by definition speculative; it is also influenced by personal views and experience, which in my case is weighted towards audio-visual media. This paper should then be seen as a basis for discussion, and not a definitive statement of the future 10 years from now.

We can learn a lot about the future by looking back into the past. In 1977, a colleague and I produced a report: 'Alternative Media Technologies for the Open University' (Bates and Kern, 1977). This looked at new technologies in the pipe-line, and already existing technologies that were not being used, including audio-cassettes, floppy audio discs, audio records, super 8 mm, video-cassettes, telephone teaching, viewdata, electronic blackboard, digital cassette vision (CYCLOPS), and home computer terminals linked by telephone to main frame computers.

It is salutary to note that, despite the potential of these new technologies, the only major change, and certainly the most cost-effective, in the British Open University's technology over the last 10 years has been the introduction of audio-cassettes, virtually replacing radio.

There are important lessons to be learned from this. Audio-cassettes are low cost, all students already have facilities at home, they are easy for academics to produce, and cheap and easy to distribute, students find them convenient to use, and when designed properly they encourage student activity (our audio-cassettes are rarely lectures). These factors are likely to apply just as forcibly to any new technologies that become integrated into distance education over the next 10 years.

A more consoling point is that it has taken 10 years before some of the technologies being discussed in 1977 have become a practical reality for distance education. For instance, video-cassette recorders and home computers are only now at a point where they are feasible for extensive use in distance learning. There are several reasons for this 10 year incubation period. Home-based technologies have to be very low cost and easy to use. It can take 10 years from the introduction of a technology into the market place before it becomes available in most homes. Furthermore, it usually takes several years from the time that a distance teaching institution positively assesses the potential of a technology to the time it is actually introduced, even on a small scale, into its teaching.

The reason that this is consoling is because it means that the future is with us now: the technologies that are going to be in widespread use in 10 years' time already exist, at least in prototype form. Any major new developments that arise over the next 10 years, and not yet known about, are unlikely to be at a stage where they will be practically useful for distance education by 1997.

A framework for assessing technology

One distinction I wish to make is between technologies for *teaching*, and technologies for *operational* purposes. For instance, technologies for teaching are much more influenced by the likely home (or student work) environment, and therefore have to be relatively low cost; technologies for operational purposes (student registration, publishing) are more likely to be introduced to improve institutional efficiency; although cost remains an important factor, a high cost of investment for operational purposes may well be justified in terms of increased efficiency.

A second distinction needs to be made between technologies used *within* a distance teaching system, and technologies used for communicating *between* different systems. The latter is particularly important with respect to European co-operation.

A third distinction that needs to be made is between different levels, types of courses, and students. Some courses (e.g. foundation and/or science courses) are likely to need a different mix of media from other courses (e.g. third level and/or arts courses.) Similarly, some students, such as professional engineers requiring up-dating, will require different technologies from others, such as housewives wishing to return to work.

It is also important to identify the most useful *criteria* for deciding on the potential of new technologies. Cost is obviously one important criterion, and learning effectiveness another. But there are other equally important factors, such as availability to students, user friendliness, and the organisational environment.

There will also be major variations from country to country in the speed at which various technologies are likely to be available, not so much for operational purposes, but for teaching purposes. For instance, the number (and type) of micro-computers in homes in France or Germany is likely to be different from that in Spain or Portugal over the next 10 years. Technology is more likely in this respect to increase inequalities between countries than reduce it, as far as the provision of distance education is concerned.

Another factor which needs to be considered, and to which little attention is usually paid, is the organisational environment necessary for successful innovation. There are basically two ways in which a new technology may be used within a system. The first is for a new technology to be *added* to an existing system. This usually means that it does not play a central role, and adds cost to the system. The second is for a new technology to *replace* an existing technology. This usually means not only changing technologies but methods of working. Changes in technologies will need to be accompanied by *structural* changes within the organisation, as well as changes in individual work-practices, to ensure that resources and decision-making powers match the requirements of the new technology. This is usually the main barrier to innovation, since those with decision-making powers are often those who control the resources associated with the 'old' technologies that are under threat.

Lastly, and most importantly, there remains the educational and operational rationales for using technology. What learning or teaching or administrative benefits will they bring? What benefits would be lost by replacing 'older' technologies, such as print? For these questions to be answered, it is necessary to make decisions about what kind of teaching and learning we want. Similar decisions also need to be made about what kind of work environment we want for staff in distance teaching. Choice of technology therefore is not just a technical decision but requires value judgements as well.

While it is impossible for me to cover all these questions in this paper, they do provide a framework for making judgements about the appropriate choice of technology, and my personal responses to some of these issues have influenced my interpretation of significant future developments.

The technologies

Text

Electronic publishing will be a major development in distance teaching. Over the next 10 years, I would expect at least 70% of the various steps in publishing to be carried out electronically in most European distance teaching institutions. It will in fact be technically possible for electronic publishing to cover all the stages, from author's first draft right through to access by students. However, 100% electronic publishing is still likely to be rare. There is likely to be some re-keying, particularly for first drafts, many institutions will still prefer to paste up graphics, where colour or high quality graphics are required, and most institutions will still print hard copy for distribution by mail to students, for reasons given on p.9. However, electronic publishing can both reduce the costs and increase the speed of production of core texts, it will enable core texts to be up-dated more easily, permitting 'demand printing' each year, and it also allows supplementary materials to be renewed each year at far less cost.

The move to electronic publishing will have major implications for work roles, requiring co-operation from the work force. It will need a considerable training programme, not only for publishing staff such as editors, but also for academic or subject expert staff.

One consequence of electronic publishing is that it will provide institutions with more flexibility for contracting in subject expertise from outside the institution. Electronic publishing will enable an author at any location in Europe to prepare materials for a distance teaching institution. This will require a re-appraisal of the benefits and disadvantages of full-time, permanent academic staff. Indeed, electronic publishing, combined with electronic mail and conferencing, opens up the possibility of small, independent, commercial institutions providing distance learning courses - possibly run by academic staff made redundant by a change to contract hiring! While the power of accreditation will be an important factor maintaining the popularity of distance teaching universities, the competition from small, independent commercial companies designed specifically to exploit the potential of electronic publishing and communications and therefore able to offer low-cost and flexible learning packages, should not be underestimated.

This raises an important issue regarding the quality of distance teaching materials. Quality control is likely to remain, indeed to become an even more important issue, where materials are remotely prepared, or prepared by commercial companies. Where electronic publishing has already been introduced in distance teaching universities, there is evidence of courses being constantly altered and up-dated, at the expense of new course development, particularly when combined with continuous enrolment. The need for strong procedures governing the production and up-dating of course materials is likely to be even greater.

However, even quality control is possible at a distance. The remote course team can operate through electronic mail and conferencing facilities (see pp.27-29). Authors can be provided with 'frameworks' for designing distance teaching materials. For instance, Shannon Timmers, of the Open Learning Institute, Canada, has designed an 'author's template', which is a computer software package that provides headings and a check-list of questions for authors to work through when preparing teaching texts at a distance.

Electronic publishing highlights the importance of clear policies based on value judgements about what kind of institutions we need and want for higher distance education. Do we want authors working to a pre-determined framework? Is the course team concept essential for quality control? These are not technological but educational issues.

It is equally important that decisions about electronic publishing are not entirely production driven. It is possible to deliver course textual material entirely electronically to students with a home computer, a monitor and a modem. However, is this the most convenient or appropriate way to provide textual materials to learners? Properly printed text has many advantages over both screen-delivered text and text printed on home computer printers. Printed text is portable, easily accessible, easy to skim and search, relatively cheap to deliver, can provide higher quality graphics and design, and above all is easier to read, compared with either home printed materials or, even more so, screen-based text. Technical developments over the next 10 years (e.g. the introduction of colour and large-screen monitors, and better quality low-cost printers; improved indexing software) may cause this view to be revised, but even these developments will not overcome some of the other limitations of electronic text, such as lack of portability.

Therefore I expect 'core' texts, while prepared electronically, will still be printed, but supplementary materials that change each year (e.g. assignment questions and cut-off dates) will be delivered to students electronically. Nevertheless, the pressure to move to 100% electronic delivery, once the high initial cost of electronic publishing and home computing has been met, is likely to be strong. The relative advantages and disadvantages of print over electronic text, in terms of learning effectiveness, does need to be researched more thoroughly, to provide stronger empirical grounds for decision-making.

Lastly, electronic publishing should facilitate considerably joint production, sharing or adaptation of materials between different institutions, at least where the same language is used, since draft texts can be electronically distributed and edited across different centres.

Audio-visual media

While nearly all European distance teaching institutions currently depend on large quantities of textual material for at least undergraduate teaching at a distance, there is a good deal of variety between distance teaching institutions in the use of audio-visual media. The British Open University makes substantial use of television and audio, compared with Fernuniversität, for instance.

The value of audio-visual media, in relation to its cost, is still a controversial issue in distance education. There is no doubt, in my view, that well-designed audio-cassettes, combined with printed material, are an extremely cost-effective medium; and that television has valuable and unique roles to play in distance education, but requires high levels of expenditure on production to exploit its unique characteristics. For me, the argument is not about whether or not to use audio-visual media, but in which forms to use them (see Bates, in press, for a full discussion of the value of television in distance education).

Terrestrial broadcast television and radio

Broadcast television, and to a lesser extent radio, could still have a useful role to play in distance education, even in 10 years' time. Broadcasting will still be an extremely valuable form of publicity for distance teaching institutions. It will still be one of the few methods of distribution guaranteed to be available to all students anywhere in a single country. However, both these roles are dependent on getting access to national broadcast channels at convenient and popular times. Broadcasting will still be the cheapest way to deliver audio-visual material to large numbers of students (i.e. over 500 students per course for television and 1,000 students per course for radio). It will still be valuable for introducing students to a subject, for providing an overview, or for raising awareness. These latter roles are less dependent on good quality transmission times, since off-air recording facilities will be available to most students in many European countries in 10 years time.

The key question though is whether it will be possible *politically* to get access to any form of terrestrial broadcast television for educational purposes in 10 years time. The advent of satellite and cable, trends towards deregulation and competition, and the relatively small numbers of students following any particular course at any one time, are likely to discourage terrestrial broadcasting organisations from giving a regular, quality commitment to transmission of distance teaching programmes.

Terrestrial broadcasting is also limited to national communication, although some cross-border traffic is beginning (e.g. UK programmes are now also relayed on cable in Belgium and Norway; Belgium can receive broadcasts from Holland, West Germany, France, and Luxembourg, as well as the UK). These are not European-wide communications though, but limited to neighbouring countries.

Lastly, production for terrestrial broadcasting is likely to remain extremely expensive, because of the professional production standards required by broadcasting organisations. Other forms of distribution, such as cable and video-cassette, do allow for more flexible and experimental low-cost production, such as tutored video instruction or use of low-cost portable equipment for collecting and editing material. At the same time, there is a high risk that poor quality production, in professional terms, may also lead to poor quality material in educational terms.

Nevertheless, this is an open issue. The dramatic reduction in the cost of production equipment for television, and the increasing availability of alternative means of distribution to terrestrial broadcasting, do mean that video production is now a more realistic possibility for many distance teaching institutions, at least in terms of cost.

Video-cassettes

Table 1: European home video-recorder access, 1987

Country	%TV Homes 1986	%TV Homes 1987
Belgium	18%	22%
Denmark	28%	34%
France	23%	30%
German Fed Rep	36%	44%
Ireland	39%	44%
Italy	8%	14%
Netherlands	37%	44%
Norway	31%	37%
Portugal	38%	39%
Spain	21%	28%
United Kingdom	51%	61%
EEC	31%	38%

Screen Digest, 1987

Broadcasting is an ephemeral medium. This has caused a number of problems for learners within the British Open University system. The loss of quality transmission time caused serious problems for us in the early 1980s. In 1977 viewing on transmission averaged 65% (i.e. on average, a student would watch about two-thirds of the programmes on a course; or two-thirds of the students on a course would watch each programme, on average). By 1984 this had dropped to 48%. The situation however was saved by the arrival in an increasing number of homes of the video-cassette recorder. The overall viewing rate is now around 60% (combining both viewing on transmission and on cassette).

Table 1 (above) gives figures for video-cassette ownership in Europe in 1987. In a survey carried out at the end of 1986 (Kirkwood, 1987), 60% of Open University students on new courses had a VCR in their own home, and 77% reported that they either had access at home or 'convenient access elsewhere'. The rate of growth of OU students owning VCRs over the last five years has if anything increased. Thus I expect over 80% will have their own VCR by 1990. It may be worth pointing out that this will far exceed students' ownership of home computers, and there is no problem of standardisation on VCRs (VHS seems to rule supreme). Furthermore, studies by the BBC Audience Research Department have found that ownership of VCRs in Britain is not income-related (except for the unemployed), while ownership of home micros is. If the trend in Britain is followed elsewhere in Europe, it seems reasonable to assume that nearly all students will have access to video recording equipment at home, or at least convenient access elsewhere, by the end of 1997, in most countries represented by EADTU.

The value of the video-cassette lies not just in its ability to allow students to view programmes at more convenient times. It also enables learning from television to be much more effective. Indeed, the video-cassette is to the broadcast what the book is to the lecture. Table 2 (below) compares the control characteristics of broadcasts and cassettes.

If a major value to students of television is its ability to link concrete examples to abstract ideas, and to enable learners to interpret and analyse material, it would seem essential that learners can access the television material at the appropriate point in their studies, that they can stop and reflect on what they have just seen before moving on to the next part of the programme, and that they can watch the same scene as many times as necessary to interpret it.–

Table 2: Broadcast vs recorded TV

Broadcast	Cassette
Fixed time to view	Available when needed
Ephemeral/once only	Repetition/search/mastery
Difficult to reflect	Analysis/relating/reflection
One speed	Individually paced
Integration more difficult	Integration easier

One lesson learned from *audio*-cassettes is that changing the technology of distribution also has implications for the design of the teaching materials. At the British Open University we are experimenting with certain design features to encourage students to make better use of the control characteristics of video-cassettes (see Table 3 below).

The increased availability of video-cassettes will have three major implications. The first should be a marked improvement in the learning effectiveness of television, if the control characteristics are properly exploited; secondly, video-cassettes offer alternative distribution possibilities for distance teaching institutions without access to broadcasting; thirdly, lower production costs for video compared with national broadcasting will make television a more practical possibility for some distance teaching institutions. Once again, though, quality control will be important.

Table 3: Implications for programme design of video-cassettes

1. Use of segments

2. Clear stopping points

3. Use of activities

4. Indexing

5. Close integration with other media (e.g. text, discussion)

6. Concentration on audio-visual aspects.

Satellite

The 1980s have been dominated by the expansion of video-cassette ownership in Europe. The 1990s will be dominated by the expansion of satellite broadcasting. To what extent will satellite (or cable) provide alternatives to terrestrial broadcasting?

There are basically two kinds of satellites, low-powered and high-powered (the latter usually called Direct Broadcast Satellites or DBS). Essentially, though, DBS transmissions can be received directly in homes using small and cheap dish aerials, while low-powered satellites require a larger and more expensive dish, with television signals usually being redistributed by cable or terrestrial transmitters to people's homes. Satellites though can also transmit voice and data signals, using a fraction of the capacity of a television channel, and hence at far less cost, a point of particular significance for distance education.

The European Space Agency's launch rocket, Ariane, has the demanding schedule of one satellite launch a month from September, 1987, over a period of several years. A substantial proportion will be European satellites, both low-powered and DBS . With a 1 in 15 chance of a launch failure, a lot could go wrong. Nevertheless, there will almost certainly be a rapid expansion in satellite capacity in Europe, from the current 21 television channel capacity to somewhere around 100 television channels within the next five years (CIT Research, 1987).

Parallelling these developments in space, there is expected to be a rapid expansion in the numbers of people capable of receiving satellite transmission in Europe, either relayed through cable systems, or through direct reception. Low-powered transmissions can now be received on equipment costing around £1,000 (US$1,600), consisting of a 1.4 metre steerable dish, a 'black box' of electronics to convert the signal for reception on a standard domestic TV monitor, and a tuner to find the desired satellite and the desired channel on each satellite. DBS on the other hand can be received on much smaller aerials (between 0.5 and 0.9 metres in diameter). The total cost of DBS reception equipment (in addition to a 'standard' domestic TV monitor) is likely initially to be around £500 (US$800), dropping eventually to around £200 (US$320).

In 1986 there were 10,000 satellite TV receivers in Western Europe. This figure is expected to rise to 1 million shortly after 1990. By 1996, 46 million (40%) of West European households are expected to receive satellite services, either directly or via cable (Tydeman, 1987). However, it will be at least 10 years before a *majority* of homes in Western Europe can access satellite transmissions, a point of significance to those distance education institutions with a genuinely open access policy.

Transmission costs range for full bandwidth television from free up-link and transmission facilities for educational users (on OLYMPUS), to £1,800 (US$2,880) an hour on Eutelsat (including transponder charges) for peak evening transmission. While not insignificant, transmission costs though will usually be minor compared to the costs of production, administration and ground support services. Neither reception nor transmission costs are likely to be a significant barrier to the use of satellites for distance education in Europe, compared with finding suitable programming, and paying for it.

Several countries outside Europe already have extensive experience of using satellites for distance education, in particular Canada, India, USA, Australia, Indonesia, the University of the South Pacific (USP) and the University of the West Indies (UWI). In addition, a number of countries have participated in Project SHARE, a series of health and education applications linking developed with developing countries via the INTELSAT system.

From these experiences, it is important to distinguish between both the media used (TV, audio, data) and the technical configuration (point-to-multipoint or network):

1. Broadcasting: the dissemination from one point to many points, for teaching purposes, with no return communications via satellite.

2. Interactive broadcasting: one-way satellite television, with terrestrial telephone used to allow students to call in (voice only) to the broadcast.

3. Two-way audio communication between several points, for both teaching and administrative purposes.

4. Two-way audio communication between several points, for both

teaching and administrative purposes, supplemented by low-band graphics such as slow-scan TV or electronic writing.

5. Satellites can also be used for carrying electronic mail, computer conferencing, text transfer and access to remote data-bases, at lower cost than even voice communication.

6. There has been no major use yet in distance education of two-way full bandwidth television communications (video-conferencing), presumably because of the very high costs.

Satellite is rarely the only communication technology; most systems using satellites in distance education also make use of terrestrial telephone services as well. As with terrestrial systems, two key questions are: why does one need full bandwidth television, given the huge difference in cost, especially if the satellite is merely relaying lectures; and why does one need to transmit, rather than mail video-cassettes?

There are several initiatives already underway for the use of satellites for distance education in Western Europe.

1. <u>OLYMPUS</u>. This large and experimental satellite, built by the ESA and able to cover 60% of Western Europe with a single high-powered television transmission, is due to become operational in 1989. The ESA is offering free transmission on Olympus to educational users and has appointed an educational programming committee, under the chairmanship of Dr. Alan Hancock, of UNESCO, to allocate programming.

2. <u>DELTA</u>. Quite independently, the European Economic Commission (EEC) is funding a large initiative, totalling £14 million (20 million ECUs), to start in 1988, to improve the technological and communication infra-structure for education and training within Europe. This project includes a proposal for a satellite-based European educational

communications network, suggesting that there will be opportunities for funding satellite-linked activities within the DELTA programme.

3. PACE. This is a consortium of multi-national companies (including IBM, DEC, Hewlett-Packard, British Telecom, Thomson, etc.), using both satellite and computer communications, to deliver a Programme of Advanced Continuing Education in Europe to companies throughout Europe, drawing on key researchers in European universities and companies. This is being funded partly by sponsorship and partly by the sale of courses, and begins in 1988, probably using Eutelsat.

4. COMETT. This is another EEC initiative, designed to increase co-operation between European enterprises and universities, through the joint production of courses and training initiatives. One strand of the COMETT programme request bids for the use of multi-media technology (including satellites), and provides funding possibilities for joint programmes between European distance teaching universities. PACE has already received some funds under the COMETT programme. COMETT started in 1987, and is expected to continue at least until 1989.

There are therefore considerable opportunities for funding distance education satellite projects of a joint nature.

It is possible to think of many different ways in which satellites could be used, but they all depend on an institution's policy regarding activities on a European-wide basis.

1. Extension of courses beyond national boundaries. There are two main obstacles to this at the moment. European distance teaching institutions do not have the resources to provide the ground support, such as registration, counselling and tutorials, at a local level, to any major extent outside their own country. Secondly, it is probably better to work in co-operation rather than in competition with other distance teaching

institutions. I understand that EADTU is developing a policy for co-operation in cred transfer, joint course production and inter-institutional co-operation. This is essential, because until decisions have been made about what roles distance teaching universities will play in providing courses across national boundaries, there is no rationale for using a European satellite facility to support courses, and no means to provide the necessary infrastructure. However, the window of opportunity for educational satellite use in Europe is quite small; time is not on our side.

2. Joint research and course production. Distance education courses cost a great deal to design. Given the high cost of design and production, there is great potential benefit in the design and production costs being shared between institutions who would also use the materials. Also, there may be areas where joint research activities between staff in different distance learning institutions, particularly research into distance education itself, could be developed. Satellite communication could be used to facilitate such activities, allowing for the exchange of materials and conferencing. However, this is dependent on co-operative agreements between different institutions being reached. Satellite communication may be one way to further this, but there may be others.

3. Establishing a distance education communications network. Satellites could form the base of an inter-institutional communication network (or even for communications within a system). Again, though, without a clear strategy for co-operation between distance teaching institutions, it is not possible to determine either the role or the likely amount of traffic for satellites in networking (for further details of how satellites could be used as part of an international educational network. see Bates, 1987).

In the meantime, while inter-institutional co-operation between the established European distance teaching institutions is slowly building up, new organisations such as PACE are stepping into the gap. PACE is specially designed to exploit the European-wide coverage of satellites and the funding requirements of EEC initiatives. It is interesting to note that only 40 of the 170 Olympus proposals were for distance education, and few of these came from the established European distance teaching universities. This suggests that there is a need for greater urgency on the part of the established European distance teaching organisations to work out how they can best work together, and how satellites might help in that co-operative working.

It is therefore possible to identify a number of constraints hindering the greater use of satellites for distance education in Europe.

1. A policy regarding trans-national distance education in Europe is a necessary pre-condition for any distance teaching institution before it can decide whether to use satellites. In parallel with defining the roles of each institution beyond its national boundary, it is also necessary to identify clear educational needs and target groups for which the use of satellites would be appropriate. This requires careful market research into educational needs that transcend national boundaries, cultures and languages. Co-operation between distance education institutions is likely to be essential to maximise the benefits of using satellites.

2. Success is likely to go to those courses which use a combination of technologies and course design appropriate to a European-wide audience. This suggests that as far as the use of satellites is concerned, there is a need to design courses specially for a European-wide audience, rather than the use or even adaptation of existing courses. It also suggests the need for new types of course design, built round satellite and other technologies.

3. Joint production of courses intended for international use in Europe is likely not only to reduce the cost to any single institution, but also to avoid cultural ethnocentricity.

4. Experience in using broadcast television and radio for distance education indicates the need to provide adequate print and tutorial support and follow-up, and the need for a clear educational rationale for using television, audio or data, for any satellite initiatives.

5. The supporting costs, and especially the cost of production, are likely to be far greater than the actual transmission and reception costs of satellites.

6. The restricted access to satellite reception for certain target groups must be remembered, particularly where open access is paramount.

7. Governments will need to ease PTT control over access to up-links and tariffs if educational use of satellites is to be encouraged. In particular, educational institutions need to be able to up-link directly from their sites.

As with other technologies, educational goals need to be determined first, but are inevitably influenced by the availability of a technology. Just as it would be a mistake for satellite technology to determine educational priorities, it would also be a mistake for distance education institutions to ignore the potential of satellites. Successful use of satellites will require some adaptation of our teaching methods, but at the same time should allow new target groups to be reached.

Cable

Probably no other medium will vary as much in its availability between different European countries as cable television. Some countries (such as Holland and Belgium) are already extensively provided; in others, such as the U.K., France and West Germany, cable penetration is low, and is unlikely to reach even 50% coverage within 10 years, under the most optimistic estimates.

There has been a lot of high pressure salesmanship about the interactive possibilities of cable television for education. However, the interaction possible on co-axial cable systems is extremely limited; fibre-optic cabling will permit greater interaction, but there will be very few homes with a direct, two-way fibre optic cable link. Distribution is likely to be via fibre optic cable for the trunking, but the links into individual houses are likely to remain co-axial, for cost reasons. 'Star' fibre-optic capability, whereby any single point on the system can link to any other point at full television bandwidth, will almost certainly be limited to intra- and inter-institutional communications, and even these are likely to be few and far between by 1997.

Cable television is essentially a local distribution facility. It has potential for campus-based higher education institutions to extend their teaching off-campus, in the areas covered by a cable network, or for local support (tutorials, discussion groups, etc.) for national distance teaching institutions. Cable may also be used as a means of distributing video programmes distributed nationally, where terrestrial broadcasting facilities are not available.

The successful use though of cable for distance education depends on the widespread availability of cable in the homes in the target area, and, as always with television, on the resources available for production. Given the limited funds available to campus-based institutions for off-campus teaching in most European countries, and given the other priorities for local support (i.e. face-to-face tutorials and personal counselling) in national distance teaching institutions, locally-produced programming is likely to be limited to relaying lectures and studio discussion, with in some cases live phone-in sessions from students and other viewers.

Cable may in some countries result in alternative distance education offerings at a local level from conventional higher education, but I would be surprised if this presents a major competitive threat to European distance education institutions. Cable may also offer an alternative system of distribution for television programmes for national distance teaching institutions where terrestrial broadcasting services are not available, but for such institutions cable is always likely to be a poor alternative to national terrestrial broadcast distribution.

Video-discs

Video-discs have great potential for education and especially training. They can be used either in a stand-alone form, in the same way as a video-cassette, but with much more precise and convenient control; or combined with a micro-computer. The latter can be used for video-enhanced pre-programmed computer-based learning, and/or as a huge audio-visual data-base, with the computer enabling access according to any pre-specified criterion.

However, the value of video-discs for distance education is likely to be severely limited over the next 10 years. There are two main limitations. The first is the lack of equipment in student homes. Less than 1% of homes in Europe currently have a video-disc player. Laservision (the most suitable form of video-disc technology currently available for education) in particular is being developed primarily for the 'professional' market. Thus while Laservision is likely to be valuable within conventional institutions, summer schools or even study centres, and also at the work-place, where the same training programme is required in many outlets, it is unlikely to find its way into a majority of European homes over the next 10 years. Currently, the minimum cost of a computer-controlled video-disc workstation is £2,000 (US£3,200), which puts it out of the home market in its present form.

The second limitation on the use of computer-controlled video-discs is the very high cost of production. There are various ways in which these costs can be kept down, e.g. joint production, where the costs are shared by several institutions, or 'generic' discs, which are basically archives of video material, around which an individual institution can write its own computer programme, but even in these instances, production costs are still relatively high, given the likely number of users.

Thirdly, the technological future of video-discs is still uncertain. CD-V (compact disc video) has just reached the consumer market in Japan. These are compact discs which combine sound and pictures, and could also include data. This technology is though just emerging, and as with all new technology of this kind, is initially aimed at the entertainment market. It is not yet clear that it will emerge in a form suitable for education, or if it does, how long it will be before educational material appropriate for distance education is available. CD-V is likely to reach a much higher home market penetration than Laservision, but I would be surprised if it is in more than 60% of European homes by 1997, given the rate of market penetration of earlier technologies such as colour TV, video-cassettes and audio-only compact discs.

Video-discs then are likely to be a technology with valuable but limited use for distance education over the next 10 years. I expect to see some development for distance education, and it is certainly a technology that needs to be closely monitored.

Computer technology

Until recently it has been necessary to use local centres to deliver computer-based distance teaching, either on terminals linked to a central mainframe computer, or on stand-alone micro-computers located at the local centre. Considerable problems have been encountered in this method of delivery, such as queueing, inconvenience, or students physically unable to reach the local centres at the times when the service is available. This has been a major restriction on the extensive use of computers for distance education.

However, in February, 1988, the British Open University will offer three courses requiring students to have a home computer, one of which (DT200) will have 1,500 students, and in 1989, it will offer a foundation course (T102) to approximately 4,000 students which will also require each student to have a home computer. This has been made possible primarily by the reduction in costs of 'business-standard' (i.e. MS-DOS) computing equipment to a level which allows students to purchase or rent machines, and by some additional funding from government sources to subsidise the courses.

It is important to distinguish between the different potential uses of home computers in distance education. I have put these in what I consider to be the order of importance:

1. Teaching about computers
2. Computers as study tools
3. Educational communication
4. Administration
5. Pre-programmed computer-based learning

Teaching about computers

There is a great demand for courses which improve people's knowledge, understanding and skills in using computer technology. Whether it is learning about programming, computer hardware, or computer systems, access to computer equipment is essential for this kind of course.

Computers as study tools

There is another important role for computers though, and that is as a general tool for helping the study process. Word-processing, spread sheets, and access to data-bases can help students with note-taking, essay-writing, and bibliographies. It is unlikely that students would be *required* to have access for this sole purpose, but students will increasingly acquire computers voluntarily for this purpose.

Educational communications

Because written or graphic information entered through a computer keyboard or even a television camera can be digitised, computers can also transfer words and still pictures between different sites. In fact, data transmission works out much more cheaply per word than voice transmission, because being digitised it can be re-coded and packed tightly, then sent very quickly to the other end, where it is decoded and unpacked back into 'normal' text and pictures, thus occupying less capacity on the telephone system than speech.

This has several major implications for distance education. It means that any student or tutor with access to a computer with word-processing software connected to a telephone can communicate with any other similarly connected student or tutor, in the form of written messages, i.e. via 'electronic mail'. Consequently, tutors can communicate quickly with students and vice versa. An assignment can be sent to the tutor, marked and returned to the student as quickly as the tutor can get round to marking it. Alternatively, tutors and students can join computer 'conferences', where everyone who wishes can contribute comments or discuss a particular topic, and where the conference is available for reading whenever the student wishes, no matter how dispersed the students. Lastly, remote data-bases can be accessed, and information can be copied from the data-base and be down-loaded into the students' or tutors' own computer and stored for later use.

Computerised communications need not be limited to mail and conferencing facilities, but can also be used for the transfer of large quantities of text, such as drafts of course units, provided that the material has been keyed in through a computer keyboard; similarly, it can be used for transferring large quantities of research data.

Such services require local micro-computers or terminals, a black-box or integrated chip called a modem which codes the computer information into a suitable form for transmission via the telephone system, a main frame computer on which resides the communications software which acts as the mail system, and good computer communications procedures.

The British Open University is introducing a computer communication system for 1500 students and 80 tutors following a course on information technology in 1988, and is already using computer communications with the Universities of Guelph, Athabasca and British Columbia in Canada, and Deakin University in Australia. It is possible to communicate in this way with any European university connected to the EARN system, provided as a free data communications service by IBM.

There are several advantages of electronic communications. First, it is relatively easy for both students and tutors to use. Secondly, there are no 'up-front' production costs, as with pre-programmed computer-based learning. The teaching and learning occurs through natural communication between teachers and learners. Thirdly, electronic communication alows for other forms of communication, besides didactic teaching, such as discussions, and socialising with other students, if at a distance. Fourth, it allows for a more open-ended and social form of learning than pre-programmed computer-based learning, thus being appropriate for subject areas where interpretation and controversy are important.

At the moment, the British Open University is using electronic communications as an additional service for students; it is possible though to envisage certain advanced-level courses where the course design would be radically different, with far greater emphasis on student-tutor communication, both by telephone and electronically, and with far less emphasis on specially prepared texts. This will have major implications for course design, will radically change the role of the academic, and will also radically change the cost structure of a course.

Administration

Once students and tutors have electronic communication, this can be used for administrative purposes as well. Student registration, fee payment via credit card, assignment grades, delivery of up-dated course or university information are all possible electronically. The potential for reducing administrative costs are substantial; however, there are also major implications in respect of re-designing admission and registration procedures, staff re-training, and changes in organisational structures. It is for these reasons that I suspect that the role of electronic communication for administrative purposes is likely to take some time to occur, and is likely to follow academic developments.

Pre-programmed computer-based learning

Pre-programmed computer-based learning refers to any form of teaching where the learner is directed by, and interacts with, pre-programmed teaching material contained in the computer software. This is called variously CAL, CBT, CAI, etc. I shall use the term CBL (computer-based learning). The distinction between CBL and electronic communication is that in the latter case, the interaction is *through* a computer terminal but *with* other sources, such as another learner, tutor or administrator, and not with the computer programme itself.

CBL can present and store information requiring low levels of symbolic representation (e.g. words, numbers and simple line drawings). It is useful for manipulating quantifiable and rule-governed variables, as in simulations. It is useful for testing students' knowledge and identifying areas where further study is necessary. It allows students to work at their own pace and to obtain feedback on their progress.

However, CBL has been around for some time now, and has come in for a great deal of criticism. For instance, a report by the OECD's Centre for Research and Innovation states:

> 'all the experts and users unanimously deplore the mediocrity and unsuitability of the courseware currently available or the high cost of good quality courseware'.
>
> CERI, 1983

The CERI report complains about poor computer graphics, no colour or voice input, and the difficulty of transferring courseware between different types of machines. Such courseware is also criticised for using poor learning strategies. There is a heavy emphasis on drill and practice, passive page-turning, and the use of limited responses (single keys or individual keywords). A major problem is that good quality CBL requires more powerful micros than those available for home use.

There is of course high quality courseware available and much of it has been developed in distance teaching institutions. However, it is very expensive to produce, and may require on-line access to a mainframe.

Artificial intelligence

Will artificial intelligence, such as 'intelligent' tutoring, or expert systems, result in better CBL, i.e. overcoming the criticisms above, within the next 10 years? This is perhaps one of the most difficult technological questions to answer. There are three possible answers to this question, depending on which experts you approach.

The first answer is: 'Yes, if you give us enough money for research.'

The second answer is: 'Yes, but not within 10 years, because the basic knowledge base on which to design useful artificial intelligence for CBL is not yet in place, and it will take more than 10 years to develop that knowledge base to a level that is useful for CBL, *and* then convert that knowledge into useful teaching materials for home-based students.'

The third answer is: 'No, not at least in my lifetime.' This may be for a number of reasons. There is a view that no matter how sophisticated the computer software and the design of the courseware, people learn best outside a machine environment, through social interaction, through feelings and sensitivities that can never be reproduced in a computer programme (see for instance, Weizenbaum, 1986). Another group would argue that although it may be technically possible to use artificial intelligence techniques to teach effectively through computer-based learning, the cost of designing and delivering such teaching materials can be justified only in exceptional circumstances, and these will not apply to the majority of subject areas to be taught at a distance. Even if such courseware could be developed, it will need so much computing power that it could not run on the kind of machines that students are likely to have in their homes even 10 years from now.

My own view is that there are already some areas where CBL is useful (those outlined on p.30), and that over the next few years a wider range of areas will be identified as a result of artificial intelligence developments and the increasing power of home micros. However, my own view is that CBL will almost certainly be only one component, and a relatively minor component, of distance learning, over the next 10 years.

This is because I believe that higher education should be as much about interpretation and the application of high-level intellectual skills of analysis, application and original thinking as about reproducing accurately handed-down knowledge, and that CBL is a long way from being able to handle much of the thinking and learning that I believe to be important in higher education.

The dominant technologies

What technologies then are likely to dominate distance education over the next 10 years, and what are the implications for distance education?

Home-based learners

Table 4: Home Access to Technology (Western Europe)

	Now	1997
Print (via mail)	→ 100%	100%
Terrestrial broadcasts (radio and TV)	→ 100%	?
Audio-cassettes	90-99%	99%
Telephone	50-90%	70-99%
Cable TV	10-80%	20-80%
Video-cassettes	30-60%	50-99%
Viewdata	1-40%	5-90%
Home computer	1-40%	10-70%
Compact disc	5-35%	50-90%
Satellite TV	0-5%	5-63%
Video disc player	0-1%	5-35%

For this group, availability of equipment in the home is, in my view, the most important criterion. If distance teaching is to be home-based, and as open as possible to all kinds of students, account must be made of the limited technology available in the homes for *every* potential student.

As indicated in Table 4, home-based learning will still be limited in *some* European countries to very few technologies for all potential students: i.e. print, and audio-cassettes. For *other* European countries, the telephone, terrestrial broadcasting (but not for European-wide education), video-cassettes and home-computing (for selected courses) will also be possible for all potential students. Compact disc players are also expected to reach high penetration in some EEC countries by 1997, but whether this will still be sound and data only, or video as well, is uncertain.

However, there will be difficulties in home-based access for several other technologies. Neither satellite TV reception nor home computing is expected to be in more than 65% of homes in any European country by 1996. This could mean that for some home-based target groups (particularly the unemployed and the less educated), these technologies will still be inappropriate for home learning, unless special provision can be made. It also seems unlikely that video discs will be a serious proposition for home-based learning in the near future. Lastly, there are very large national variations, particularly regarding cable TV and viewdata (i.e. telephone-based teletext services).

It can be seen that increased dependence on technology for teaching can not only widen the difference between provision in different European countries, but can also reduce the open-ness of an individual institution.

On the other hand, technology does make possible (indeed requires) a wider variety of course design. I foresee three main kinds of course, with a variety of intermediate positions:

1. The current, primarily text-based course, but with greater use of electronic publishing.

2. 'Lecture-based' courses, using cable, satellite or video-cassette based technology, supplemented by set reading (text-books, etc.).

3. Electronic courses, using the telephone and electronic communications, with limited textual support, based primarily on interaction between tutors and students on a regular and on-going basis.

It is likely that these different kinds of courses will be directed at different kinds of students.

Centre- or work-based learning

To some extent, this decision will depend on what technology is already available for other purposes. For instance, if every employee to be trained already has access to their own computer terminal and screen for work purposes, then this can be used also for training purposes. Certainly, education and training located at the work-bench or in local centres will be less restricted. For instance, at a reception or work-station cost of between UK£400 and £1000, satellite TV and computer-based learning become realistic propositions for individuals at their work-place or in local centres. Even video-discs become viable where they can be shared by several users, or in businesses where they are likely to have another function as well (such as marketing holidays in travel agents).

Communications within and between systems

There are far fewer restrictions on the use of technology here. Virtually anything should be possible in 10 years time. Technology can be used for training of tutors and regional staff at a distance, for joint production of courses between different institutions, and for development of joint policies between institutions, all done at a distance. For instance, using a combination of telephone teleconferencing and electronic mail, this 'meeting' could be held without any of us having to travel from our desks.

However, for this to happen, a number of steps need to be taken. Policy-makers and academics in each institution need work-place micro-equipment and electronic communication facilities; there needs to be common standards agreed for electronic mail; governments and the EEC need to be lobbied regarding satellite regulation. These are primarily technical issues, but they depend on policy regarding co-operation between institutions being put into place first.

Conclusions

Technology for home-based learning will still be relatively restricted in a number of countries, even 10 years from now. For some countries, there will be a wider range of technologies for distance teaching, and greater potential for cross-national delivery of courses. This could lead to a much wider variety of course design and delivery, with major implications for organisational structures and work roles. There is a danger though that too great a commitment to new technologies could limit the open-ness of ditance teaching institutions. Communication within and between institutions will be considerably eased by technology, although steps need to be taken now to standardise technology and procedures between different institutions.

Technology will change the nature of the distance learning experience. Technological developments need to be preceded and accompanied by research and evaluation, to monitor carefully not only the learning but also the cost and organisational implications. It is important that research priorities are carefully defined. At the moment, governments are giving priority to basic research in the areas of artificial intelligence, and for development of interactive video. However, distance teaching institutions should be investing in more immediate and practical issues, such as monitoring student access to equipment, the design implications of video-cassettes, evaluating new types of course design based on new technology, and studying the cost and organisational implications of introducing new technology.

The main point to emerge though is that technological decisions need to be preceded by policy and educational decisions, although at the same time it needs to be recognised that the availability of new technology does allow for major changes in the way we teach at a distance. The choice to be made though is not what technology but what kind of teaching we want to provide.

References

BATES, A.W. (1987) *Satellites for Commonwealth Education: Some Policy Issues: Main Report* London: Commonwealth Secretariat, 63 pp.

BATES, A.W. (in press) 'Television, learning and distance education', *International Council for Distance Education Bulletin.*

BATES, A. W. and KERN, L. (1977) *Alternative Media Technologies for the Open University* Milton Keynes: Open University Institute of Educational Technology, 72 pp

CIT RESEARCH (1987) *New Satellite Communications in Western Europe* London: CIT

KIRKWOOD, A. (1987) *Access to Video Equipment for Study Purposes-Undergraduate Students in 1986* Milton Keynes: Open University Institute of Educational Technology, 18 pp.

SCREEN DIGEST (1987) 'World Video Markets Review', *Screen Digest*, November, pp.249-256

TYDEMAN, J. (1987) *Cable and Satellite Television Reception in West Europe* Luxembourg: Societe Europeenne des Satellites

WEIZENBAUM, J. (1984) 'Artificial intelligence' in *Computer Power and Human Reason*: London: Penguin