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AN EVALUATION OF THE IMPACT OF INTERACTIVE VIDEO SYSTEMS IN EDUCATION AND A MODEL FOR TURKISH DISTANCE EDUCATION SYSTEM-I

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INTRODUCTION

Technological innovations are of interest to educators because they may have the potential to make education «easier, cheaper, more efficient and more attractive» (Hart, 1987, p. 171). Interactive video is a recent development that synthesises the advanced technologies of video and computers. In societal terms, spectacular claims are being made for the impact that the new medium may come to have- it presages a «revolution in communications technology» (Parsloe, 1983, p86) that may alter fundamentally the way in which information is stored and shared. In education, the promise is as great. It is argued that interactive video would do more than just add to the range of available teaching systems, rather, it would offer important new ways of learning. Interactive video would mark the end of «passivity» in learning and replace in with learning based on activity and involvement. Interactive video enables learners to

> «... interrupt, interrogate, repeat or pause, adjust the pace, scan, review and quickly locate material according to their individual need». (Hart, 1987, p172)

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For some, then, interactive video offers exciting new possibilities in pedagogic design. For others, however, the new medium is viewed as an impressive and expensive audio-visual aid - the current need for costeffictiveness and budgetary restraint may often disqualify interactive video from consideration. Such arguments would point to the fact that in 1985, after ten years of availability, only 60 per cent of primary schools owned a video recorder. Moreover, it required a massive funding programme from the Department of Trade and Industry to reach an average provision of one computer per 150 children in British schools (Bates and Hill, 1985). Improvements since that date are likely to have been incremental, rather than sweeping. These figures suggest that the penetration of new technologies into mainstream education is a difficult process, and any evaluation must take this into account.

> «There are almost no aspects of education that interactive video might not affect but there is still a huge question over whether it will ever affect any of them». (Doulton, 1984, p205).

This paper will attempt to evaluate the likely impact of interactive video in British education and to suggest a model for Turkish distance education system. Evidence from other countries and from industry, as well as the results of research projects will be brought to the argument. The claims and counter-claims of commentators will be appraised against a backdrop of economic and institutional constraint and government policy.

The work will have the following structure: Section One will examine the nature of the technology. Section Two will situate this development by exploring the theoretical justification of interactive systems in general. Section Three will examine the strengths and weaknesses of interactive video as an interactive medium, and a range of real and possible applications will be used to illustrate the argument. The second half of this work will depart from the examination of the medium itself, and will move on to look at the educational setting in which development may take place. All levels of education, from the universities and colleges through to the vocational sector and schools will be considered. Corporate training in industry and commerce has provided an early testing ground for interactive video techniques, so developments in this area will also be explored. Institutional dynamics, determined by economics, culture and political climate will play an important role in the future

of interactive video - Section Four will be devoted to the discussion of this «political economy» of the new medium.

Section Five will look in detail at the one initiative that has had some impact already in British education - the BBC's Domesday Project. The learning opportunities provided by the project will be explored, and the prospects for future innovations on the basis of the project will be considered. As the Domesday Project was, in part, sponsored by the government, the sixth section of this wirk will locate government policy as a key determinant of future development. Two governmen-tunded schemes for interactive video will be discussed, and their impact on education in general will be assessed. In section seven, a model for Turkish Distance Education System will be suggested.

On the basis of the exploration of the capabilities of the medium, and on an examination of the context for development provided by the British education system, and for the model for Türkiye, general conclusions on the impact of interactive video will be drawn.

SECTION ONE

Interactive video - the technology

The term interactive video describes the combination of two modern technological forms - computers and video. Both have had considerable impact in education in their own right, but together they become a new educational tool that has been described as the «most powerful individualised learning medium so far developed» (Roach, 1984, p187). The fusion of the two forms generates a substantial rise in capability. Similarly, the number of possible applications increased .It will be argued here that these changes are of an order that represent a qualitative shift in terms of what can be achieved by the use of such media - the combination is greater than the sum of the parts. In short, the marriage of video and computer technology provides high quality still and moving pictures with full sound capabilities, allied with the responsiveness, interactivity and diagnostic power of computers derived from computer-assisted learning and computer-based training.

Gindele and Gindele (1984, p83) have described the videodisc, upon which many interactive video systems are based as «a point of convergence for all media». It is the capacity to store information

as text, sound, still photograph, moving pictures and computer graphics, along with the ability to process this information with the speed, accuracy and complexity that is offered by modern computing that gives interactive video its uniqueness and its place at the cutting edge of developments in educational technology. Interactive video offers the learner a «multiplicity of communication codes» (Hart, 1984, p207), thus creating an engaging and dynamic learning environment which: :

> «... adapts to the aptitudes and abilities of a wide range of students and subject areas, thus allowing students to compare, contrast and follow their own investigatory pathways». (Plummer, 1985, p246).

Such a powerful new technology should aid the realisation of educational goals within existing methodologies, but beyond this it could be argued that interactive video could come to have a dramatic and fundamental effect on much existing educational practice. It has been suggested that interactive video may come to have an impact «equal to or greater than that of print technology some 500 years ago» (Gindele and Gindele, 1984, p96). Whilst this statement is based on a long historical view and some speculation, there are consequences for educators in the shorter term. The design and development of teaching materials may have to be framed in completely new ways in the light of the new techology, and interactive video may prove to be «a considerable challenge to the educational world» (Laurillard, 1987, p11).

Interactive video has beeen a technical possibility for almost twenty years. Current developments in interactive video stem from the low cost, power and availability of the modern microcomputer and the development of the videodisc as a storage medium for video signals. Although disc technology is much more expensive than the tape systems that preceded it, there are several reasons why it is disc rather than tape that has led to a growth of interactive video applications. These reasons will be discussed below after the general nature of the technology has been described.

In modern educational applications interactive video typically consists of one or two television monitors, a microcomputer, a video player and a connecting interface that permits communications between player and computer. There are more simple configurations and a descriptive scale developed by the Nebraska Videodisc De-

sign/Production group has passed into common usage. Thus, a non-interactive system of, say, watching a video from start to finish would be termed «Level O» on the Nebraska scale. Many modern domestic and educational video players incorporate a range of sophisticated control functions, indeed these are often used in classroom situations. Using such controls as search wind, slow motion or freeze-frame permits a rudimentary amount of interaction with the source material. Such use is described as «Level 1» on the Nebraska scale.

At «Level 2» a small computing facility built into the video player itself provides random access to video segments, thus allowing selective replays or «branching» where users would progress through the material in different ways according to need and preference.

Level 3, already referred to above, replaces the video player computer with a separate microcomputer and interface; the system is enhanced by the increase in computer power. The system is able to use information provided by the computer's own memory, often overlaying this information on the video picture. The calculating speed and power of the computer makes «real-time» interactions possible. Additionally, the computer can monitor the progress of the user, make branching decisions accordingly and present course controllers with profiles of user performance. It is at this level that many educational applications are being researched.

The technology is so new, and the rate of change is so fast, that the Nebraska team have reserved «Level 4» to describe configurations yet to come. Systems with access to distant data-bases or systems based on a reusable disc may occupy this level. For the time being, though, it is «level 3» systems that are exciting the interests of many educational technologists. Such systems are, themselves, massively powerful and their full potential has not yet been realised. Indeed, the capabilities of the medium seem so extensive that proper knowledge of effective application techniques has not yet emerged.

> «At the moment everyone involved with interactive videodisc is on a learning curve and there are big black holes waiting for the unwary». (Griffiths, 1984, p200).

As has been said already, the spur to recent developments in interactive video from the emergence of disc as a medium for video

signals instead of tape. Paradoxically, these new developments also rekindled interest in tape-based systems, both in research and in budget applications, and these will be discussed later. However, it is disc technology that offers the most potential as part of an interactive system. Tape systems have reputation for being slow, noisy and unrealiable. This reputation may be unwarranted to some extent, but it does remain an almost intractable limitation of the medium that it is essentially linear. that is, in operation the tape passes a playback head, and the tape has to be «wound» to the appripriate place before playback can start. This means that sections of video material can be located at considerable distance from one another, and this distance translates into time wasted as the tape winds.

By contrast, disc systems allow access to any part of the stored material in any order at any time and access times are usually in fractions of a second. Effectively, access is instantaneous and any interactive use feels smooth and seamless. Discs bring «elegance and ease» to video searching (Fox, 1985, p82). Optical discs share much the same technology as domestic compact disc players. Discs are «mastered» for life, are not reusable, and are extremely hard wearing and reliable. The format is larger than for compact-disc players, so a videodisc resembles an iridescent silver long-playing record. There are two systems vying in the market-place for dominance, in much the same way that systems competed in the early days of domestic video, before VHS gained the upperhand. Philips and Pioneer have developed Laser Vision or Laser Disc, whilst Thorn-EMI in association with JVC market a system called VHD. The Laser Vision system seems to be in the lead at the moment, but the contest is far from settled. VHD discs offer 60 minutes of playing time per disc, in terms of moving picture capacity, but this represents up to 45,000 still pictures or pages of text, or any combination of stills and moving pictures to a notional total of 60 minutes. Often mentioned disadvantages of this system are an inability to hold random moments of moving picture as a freeze-frame-stills have to be pre-specified at the design stage; fragility of the discs -the «grooves» are open and so the disc is never moved from a protective sleeve, and in addition, there is actual contact with the disc by a reading stylus and so there is the possibility of disc wear and deterioration. There is no evidence as yet to prove that this does occur.

By comparison, Laser Vision discs offer 37 minutes of playing time per disc side or 55,000 still frames or any combination of the two. Any moment can be frozen as a still frame; discs are durable and can be handleddirectly, and as there is no contact during play there is no possibility of wear.

Both systems offer high quality television pictures, allied with stereo sound. The two audio tracks can be put to a variety of separate uses. Both systems offer fast access, and both can receive instruction in a variety of ways according to programme design. Interaction may take place via the computer keyboard, mouse control, remote keypad, light pen or touch-screen system. The future offers the possibility of voice control (Jarman, 1986, p38).

Such advanced technology carries a heavy price tag, and in addition, the mastering of new discs is an expensive proposition, beyond the means of individual teachers and schools. Tape systems do offer a way into interactive video for those on restricted budgets. Furthermore, the loss of sophisticated interactivity can often be more than compensated for by the sense of active engagement that even a tape system can deliver. Tests have found that relatively simple taped-based systems are popular with students (Laurillard, 1985). Advocates of the low-tech, low-cost option argue that tape-systems can develop interactive video in schools now, by using existing computers such as BBC and Apple-Macintosh with VHS tape players that cost little or no more than those that schools are likely to buy in any case. The only «exotic» (Laurillard, 1982, p179) component is a specially designed interface which could cost £200, but this outlay opens up the prospect for immediate application of interactive video in schools and the possibility that teachers and pupils could make their own interactive video material (White, 1987).

There are other strategies available that can bring down the cost of interactive video considerably. For disc, especially Laser Vision, video material has to be initiated on near-broadcast quality tape prior to being mastered onto the disc. The costs of such production are substantial. Such video production involves specialist teamwork and expensive hardware. Eventual costs can reach thousands of pounds per minute of finished video material. If existing video material could be used, providing that it is suitable for restructuring to an interactive format, then considerable amounts of money could be saved and the possibility of interactive video pro-

duction may stay alive where it may well have not survived if full costs had to be met. The Open University have experimented successfully with archive material (Williams, 1984), and the existence of an extensive video archive at the Open University, all of it up the required broadcast standart is an encouraging situation. Similarly, the BBC, themselves very interested in the promotion of interactive video systems, have what is probably the world's largest stock of broadcast quality video. A recent interactive videodisc, entitled «Volcanoes» is a testimony to the rich seam of educational material that could be converted for use in a new and exciting way. The Volcanoes disc will be discussed more fully in Section Five. A recent FEU/Pickup report (Interactive Video in Further Education, p12) struck a cautionary note, however, and pointed out that much archive material may prove to be as limiting as it is enabling, and that such a dependence would result in interactive video failing to realise its full potential. The report suggested a new categorisation of such material as «computed-enhanced» or «computer-assisted» video, reserving the label interactive video totally new programmes using purpose-made video material.

In Sections Two and Three the case for interactive learning systems will be examined in some detail and the contribution that interactive video may be able to make will be fully explored. The foregoing discussion has described the technical basis of interactive video systems; it is now necessary to describe in broad terms how interactive video could be used; indicate its possible strengths and show precisely the nature of the interaction that such systems are able to offer.

Mably lists seven separate uses for interactive video in schools. The list is not intended to be exhaustive, but it does give some idea of the power and flexibility of the medium. Mably says that interactive video could be used

> «... as a teacher's lesson aid;
> as a resource for teacher planned group work;
> as an individual study (teacher-planned) resource;
> as an individual study (pupil-planned) resource;
> as a teacher in-service aid;
> as a televisual data-bank resource;
> as a programmed teaching/learning tool.» (Mably, 1987, p195)

He goes on to envisage further specialist applications in special needs education, English as a Second Language, and as a simulator.

Each of these applications will be looked at in more depth later, but the broad sweep of the claimed relevance of interactive video is quite apparent from the list. Other authors have suggested why interactive video may be a good choice for course designers. Hart (1984, p207) has argued the strengths of interactive video. Firstly, it offers reliable repetition of lessons across distance and time. This is true of predetermined presentations, as well as of responsive, branching systems. Secondly, interactive video offers a variety of sensory stimulations and presentation formats. It is potentially far less monotonous and predictable than other media. Thirdly, interactive video has the capacity to be accurately «targeted» to an individual learner's requirements, and individual control of pace, sequence, level and timing are all possible. Fourthly, the system is transportable - high quality instruction can reach remote areas without deterioration or loss of curriculum control. Furthermore, the system allows constant monitoring of individual and programme performance, and has inexhaustible patience. And lastly, the systems are durable and with careful choice of programme material should offer a long shelf-life. Again, these claims for interactive video are offered at this stage for illustration only; indeed from certain perspectives some of these «advantages» may be viewed as dubious - and these issues will be aired in Section Three.

Finally, as far as broad illustration is concerned, something can be said about the use of interactive video. Much has already been made of the interactive power of the medium, but what does this mean for the learner who uses such a system? Laurillard (1985, p39) identified nine ways in which the Open University's Teddy Bears Disc interacted with users. Each of them is a device, or trick of the trade, for programme designers and it is an interesting combination of approaches that is likely to make a successful programme. Laurillard lists the nine modes of interaction as follows: information testing; information giving; tested observation (What do you notice...?); untested observation (Look at ...); hypothesis framing (What do you think ...?); procedural information, giving programme instructions; hints that guide students towards correct responses; corrective instructions (Be more precise ...); and, simulations that permit students to perform surrogate experiments.

Laurillard's list, even in this summary form, is indicative of the potential richness of the interactive video learning environment. At root, it is an active medium, constantly challenging learners to be-

come involved in their own learning. It could be argued that interactive video has a rather sinister aspect, a further step in the process that replaces people with machines - bit even here interactive video has its champions who describe it as a «warm and personal medium» (Parsloe, 1983, p83) that compares favourably with more traditional educational methods - the comparison will be explored in Section Two.

This section has explained the technology behind interactive video, and has given some account of the potential, strengths and applications that interactive video may have. Although an almost universal relevance seems to be claimed for interactive video by some authors, it is obviously true that no one technology is likely to be a panacea to cure all current educational ills. Hart (1987, p171) suggests that some educationalists view any technological solution as «a fix» -that is, they become «hooked» on technology, rather like drug users. The real strength of interactive video lies in its intelligent application in specific areas of the curriculum where clear benefits can be obtained. Parsloe urges that a realistic attitude to the application of interactive video should be maintained.

> «Every situation has to be evaluated on its own terms: much as interactive video has to offer, often providing a wholly new and revolutionary alternative; other methods are sometimes more appropriate». (Parsloe, 1984, p202)

With this in mind, Section Two will look at the case for interactive learning systems in general and will go on to explain the place of interactive video as the highest expression yet of interactive methods.

SECTION TWO
Interactive Systems

In the foregoing discussion of the technical nature of interactive video, the specific capability of the system to offer individualised learning through a televisual medium has been described. If interactive video is to have a major impact in education, this is contingent to a large extent upon the significance of interactive methodologies in general. If the movement towards individualised learning gathers momentum, then interactive video systems should enjoy wide application. The education system already makes extensive use of mediated instructional systems. Books are a mainstay of

contemporary education, but educators have also used technologies such as video and computers to promote learning. The value of interactivity is already expressed in the use of classroom discussion; the performing of exercises at the ends of chapters in books, or in the use of an audio-based language laboratory. This section will look at the value of interactive learning systems in general. Then, more specifically, the nature of interactivity in computer-based systems will be discussed. Computers represent the highest expression of the interactive method before the development of interactive video. It is important to look at their strengths and weaknesses in some detail so that the precise contribution of interactive video can be ascertained. This exploration of other educational technologies will clear the way for an examination of the potential of interactive video in Section Three.

Throughout history educators have been keen to harness various technologies in the pursuit of their goals. A straightforward «Socratic» dialogue between expert and learners is still a remarkably common educational form, but more often than not teaching and learning are mediated by a range of technologies. At a rudimentary level, even a blackboard and chalk represent a technical mediation and the possibility of effective or poor blackboard use becomes an issue. And so it is with all other technological forms - in the abstract, the capabilities of any particular technology are probably benign or neutral, it is in particular choices regarding configuration, deployment and pattern of use that educational concerns arise. Thus, educational technology has emerged as a specific discipline that explores the application of technologies across the range of subjects and situations. Educational technology is

> «... an enterprise that uses research and development techniques in close combination to build knowledge and understanding of how students learn through different kinds of teaching media and methods, and how these should best be used in order to facilitate efficient and desired learning». (Laurillard, 1987, p74)

Any exploration of the impact of interactive video is, therefore, within the remit of educational technology, and so it is important to situate this new medium in a broader context technical innovation. The book has played a major role in education systems ever since the rise of industrial printing techniques that accompanied the industrial revolution (Smith, 1986). So embedded in educational life is the use of print media, that it is sometimes possible to lose

sight of the fact that books represent only a specific application of technology to educational enterprise, and that like any other form they have advantages and disadvantages.

Gindele and Gindele (1984, p144) offer a critique of the book as a learning medium. They point to the barrier that literacy skill acquisition may provide and they suggest that a high degree of user motivation is required for sustained study. The lack of sound and motion are obvious limitations of the form, but books do provide a limited amount of interactivity. Index systems permit a user to find individual routes through the total material. Some books even provide tests and checking systems to give a reader some degree of performance monitoring, but the extent to which such sections are used cannot be controlled. Books have emerged as a relatively cheap, widely available medium and it is no surprise to note their preeminence in mass education systems.

The twentieth century has seen the rise of photographic and electronic media to complement print media in education. Slide, tape/slide and film have found extensive use in schools and colleges, although their use has been only for purposes of exposition, any subsequent dialogue has had to be organised in a traditional way through the teacher/expert. Re-usability, relative cheapness and convenience of use have let to the displacement of much film by video-tape systems. Skip, search, slow-motion and freeze-frame controls have progressively ushered in a level of control over the material that was never possible with film systems. The advantages of videodisc players over video tape systems have already been discussed, but numbers in schools and colleges in Britain, as they are in, say, Japan and the USA. This point will be more fully discussed in Section Five.

Largely separate from these developments in visual communications technology, the last thirty years have seen the rapid and dramatic rise of modern computer systems. In what amounts to a second industrial revolution, industrial and commercial practices have been overturned by the application of computer techniques. Education and training have followed along in the wake of such rapid change, and whilst private investment in computer-based training systems has been relatively healthy, it is the school and college systems that often seem to be last in the queue for compuuter led innovation. Nevertheless, education and training both make exten-

sive use of computers in specific educational applications, and many curriculum areas, from «hard» science to humanities, make regular and habitual use of computers. It is against the background of these parallel applications of visual and computing media that interactive video is emerging as a new synthesis.

As far as education is concerned, and the state school system provides an ideal example from which general principles can be extracted, the typical framework within which learning is expected to take place is that of the classroom - one teacher with many pupils. There is nothing ironclad or inevitable about this state of affairs, but the slow processes of historical institutional decision-making have made the class the universal educational unit. Such an evolution has led, for a variety of reasons, to the emergence of an appropriate style. An active, didactic teacher leads «from the front» a series of expositions and exercises in a highly controlled manner towards a pre-specified learning objective. The reinforcement of virtues of good behaviour, attentiveness and obedience has led to a situation that has aften been characterised as «passive» from the learners, point of view (Laurillard, 1987, p11).

The last twenty years has seen a dramatic rise in the number of educational practitioners who see this typical configuration of the classrom as constrictive and limiting.

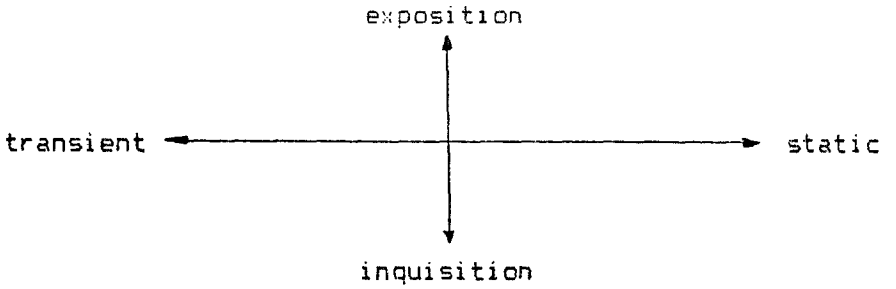
> «I firmly believe that it makes for sounder learning if a child does something rather than just watch or listen». (Jarman, 1986, p38)

Activity has become the watchword of the era in some circles - project work, group work and a wide range of creative activities, like, say, video making have become important methods in schools. For some, schools are understood to be an institutional negation of learning and new forms have been seized upon to break the grip of institutionalised drudgery, and it is common to hear critics savage the orthodox notions of good classroom practice. «The biggest problems that schools have are boredom, fear of failure, and lack of relevancy» (Wilson in Dowling and Camstra, p148).

It is against this background of dissatisfaction that technological aids to education have come to be assessed. The passive/active dichotomy is often used as a direct measure of a medium's relevance to the modern classroom environment. This is not to say that exposition and reception are seen to have no part to play, but

that many theorists expect to see an overall emphasis on active methodologies to secure learning. Beneath such preferences are models of how learners behave and what different technologies have to offer. Clark (1984, p190), for instance views learning as a dialogue which aids personal discovery. The dialogue may often be with a teacher, but may also be with a teacher-surrogate in the form of books, films, computers and so on. For Clark, the quality of a learning medium is determined by the quality of the dialogue it is capable of sustaining. In dialogue, knowledge is developed through a series of «tentative acts of imagination», as hypotheses are tested out had «educated guesses» become consolidated as «knowledge» (Clark, 1987, p70). Similarly, Bork (1987, p28) argues that «interaction, involving detailed communication is a critical human activity». Obviously, both authors are interested in how educational media can turn a classroom into an environment where tuition is focused upon individual needs and responses, rather than on the «broadcasting» of traditional methods.

Arguing from a different perspective, Griffiths (1984, p196) is able to show which media are most likely to meet the challenge of interactive use. He uses Copeland's model message systems as a guide:



So, broadcast television would be seen as transient exposition, whereas books would be understood as a static form of exposition with a few elementary powers of inquisition. All media seem to cover only parts of the available spectrum. Computer-based training is a strong inquisitive medium, but has limited facilities for proper exposition.

For Clark, a key concern is the extent to which a medium can be brought under the direct control of the learner, because the processes of dialogue and reflection are likely to take place at the lear-

ner's own pace, that is, in what he calls the learner's «subjective time» (Clark, 1984, p190). Books are able to offer only a flawed dialogue because they do not receive or respond to information, but they do offer the possibility of learning in subjective time. Viewed in this way, a lecture offers negligible time for reflection and interrogation, and a video programme, for all its modernity, is similarly flawed as the learner loses all control of pace and ability to question. Only with the rise of computer-based learning systems does Clark see the beginnings of the establishment of interactive learning media, wherein a meaningful and student controlled dialogue could be sustained.

Before going on to look at the advantages of computer-based systems it is probably worth exploring in more detail the strengths and weaknesses of stand-alone film and video systems. It should then be possible to estimate the capabilities of interactive video technology that draws on both computers and video.

The above discussion has been critical of video insofar as it is viewed as a passive medium for the purposes of exposition - the flow of a video programme does not generally allow for self-paced reflection. However, there can be no doubt that classrooms would be poorer places if this rich audio-visual resource were removed. It is in the ability to show, with photographic realism and high-quality sound, phenomena that would not otherwise be seen in a classroom that gives video its strength The only valid comparisons are with pictures in books and with colour transparencies or tape/slides, and the combination of movement and sound would tend to give video the edge. Fuller (1987, p17) uses Miller's categorisation of when film should be used in the classroom, and it applies equally well to video. Film should be used where a phenomenon, process or object is too small for easy observation; or too large; or too fast; or too slow; or too hazardous; or too rare; or too uncertain for reliable demonstration. In addition, film is useful where special equipment would otherwise be necessary; or where graphic overlay could give emphasis or where screen information can be used as data-source. This amounts to an impressive list of potential applications - despite being poor interactive media, video and film are excellent expository media. Laurilard (1984 (1), p7) strives to move beyond the simple labelling of such media as «passive» and argues that «receptive» might be a better description, saying that experiments have shown that students are engaged, by and enjoy using, the medium and are

receptive to the lessons of film and video instruction. For Laurillard, it is the proper blend of learning modes that is of concern and a receptive medium like video needs to be complemented by other active media to create an excellent learning environment. All in all, video emerges as a powerful and indispensable medium for certain learning objectives; for instance, Boyd and Pask (1987, p83) recommend video for «its ability to show human models of mastery with which the learner can identify». Even when the limitations outlined earlier are taken into account the conclusion can be drawn that video is a powerful aid to learning in the modern classroom.

The case for interactive, individualised educational media has been made and other media have been appraised. These other media, despite their considerable strengths either do not offer any interactivity or do so only in an uncontrolled and haphazard way. Clark's argument that computer based systems offer the first truly interactive learning medium has already been mentioned. The strengths of this educational form can now be explored. Much of the development of computer-based systems has gone on outside of the education system. Trainers in private companies and corporations have been quick to invest in computer-based training. There is a straightforward economic rationale for this - the school system is rooted firmly in a high-labour cost provision, whereas companies are more likely to choose high capital, low labour cost solutions to training needs. This propensity will be further explored in Section Four. Consequently, much of the literature is based on training applications, but nevertheless, the properties of the medium can be read off and the application to the school system can be inferred. In the case of vocational education in further education the distinction between education and training becomes blurred in any case and so the lessons of industry are more directly applicable.

Kearsley (1983, p1) describes computer-based training (CBT) as «an inherently active mode of learning» and he goes on to suggest that it is this interactive nature of CBT that underlies virtually all of its benefits. The goals of any educational method invariably include efficiency and effectiveness, and Kearsley (ibid, p5) offers ten key features of CBT that make it attractive to many course designers.

Firstly, CBT offers a high degree of control over the training that does take place. Training can thus attain a high degree of standardisation across time and distance, as the human elements of tra-

ining deployment are reduced. Lessons are not mediated by the interpretations, preferences and prejudices of individual tutors, nor are learning outcomes adversely affected by personality clashes between tutors and students. Instead, the same learning outcomes should be attained by all trainees wherever and whenever they train. Clearly, this capability will appeal to corpoorate trainers, but maybe the reduced scope for individual and local interpretation would be viewed negatively in a school system. Those who are opposed to the establishment of a national curriculum would doubtless be wary of the rise of CBT methods. On the other hand, it may be reassuring for some topics like, say, the safe handling of chemicals to be taught in a proven and standartdised manner.

Secondly, CBT may reduce significantly the resources required for training. Training can be decentralised by the application of CBT. Travel time and expences can be reduced. Courses can be shortened in duration if some elements are pre-taught by CBT techniques. The National Interactive Video Centre are demonstrating a Jaguar Cars disc that has reduced a five day course to three days by pre-teaching course objectives at the place of work. By the same token, CBT offers huge potential as a medium for distance-learning programmes. It is also possible that an educational establishment may train more people in the same time by using CBT workstations-that is a higher «throughput» may be achieved. In terms of classroom practice CBT can be left to perform routine training whilst the teacher is freed to concentrate on queries and problems - potentially this amounts to a much more effective use of the scarce resource that a teacher represents. Other resource saving are possible if computers are used to simulate processes that would otherwise depend on expensive eqipment. Flight simulators are an obvious case, but other more mundane applications like materials testing or welding can be usefully simulated, and savings in materials can be made.

The tension between the value of individualised learning and the difficulty of establishing it in a classroom setting could be resolved by the application of CBT techniques. Kearsley's analysis leads him to his third point, that CBT offers a supreme medium for individualised learning, the only constraint being the number of work-stations that can be provided. In CBT, students are able to work at their own speed, and they are also free to repeat, practice and skip as they wish. Thus, learning can take place in a students «subjective time».

Furthermore, and this is the fourth point, CBT has considerable advantages in forms of timeliness and availability. Teacher based systems depend upon timetables and rigidly planned periods of tuition. CBT offer the possibility that learning can take place in a more flexible way. Whoever needs CBT can gain access almost whenever they choose, and multiple provision of work-stations could deliver programmes wherever they were needed. The basic point is that teaching and learning would not necessarily cease as a period of tuition came to an end.

Fifthly, Kearsley puts the economic argument that training is «downtime» - that is, it is a time when workers are not productive. If CBT reduces training time, then this «down-time» would be reduced and the productivity of workers could be increased. This point does not seem to be of direct relevance to schools and colleges, but if CBT did reduce the time spent in achieving certain goals, the curciculum could be extended and schools could offer a richer experience .Also, in a cost-consious era, staff-training in schools and colleges could be well understood as down-time, so CBT techniques may be able to make a contribution in this domain.

Sixthly, Kearsley claims for CBT that individualised learning leads to better job performance. This is due in part, he says, to the quality of learning that is possible in the active CBT environment, but he also claims that CBT encourages good habits of concentration and attention, and therefore has a general formative effect upon users. This is an assertion particularly if the further assertion is added that traditional classroom practices may generate considerable restlessness, boredom and alienation. At deeper levels the argument is more disturbing as it suggests that people may become more human through relations with a machine.

Kearsley points to the ubiquity of computer systems in everyday life. As these expensive machines are purchased in any case, their further potential in CBT should be exploited. He notes the rise of «embedded» training systems, where machines used in a particular job, say, banking or hotel reception, carry training programmes that teach the procedures of the job itself. Staff can shift from work to training at the push of a button, or can solve problems when the need is apparent, rather than in abstract classroom situations. It is difficult to see a direct relevance of this facility in the school system, though vocational education needs to take note of these impor-

tant developments. Nevertheless, this facility does ably demonstrate the qualitative shift in training methods that CBT represents.

CBT can be viewed as an agent of progressive change. It is Kearsley's eighth point that CBT has a healty hidden curriculum. As a computer based system it increases familiarity with the medium, at a time when such aptitudes are at a premium. In other words, CBT spreads computer literacy. As a further example, Kearsley suggests that CBT may have the power to alter current perceptions of, and attitudes to, disability. Many disabled people are fully skilled at a computer keyboard, and full potentials are likely to be more fully realised through the medium of CBT.

Further, Kearsley asserts that CBT increasses learning satisfaction. Constant interaction is held to be an enjoyable mode of learning and as such the medium is intrinsically motivating. Furthermore, the system's ability to deliver appropriate feedback at the right time is a sound encouragement to continued learning. The CBT experience reinforces the learner at every stage, and if well-designed should never let a learner flounder in confusion, carry forward misconceptions or «lose» a learner through boredom and disengagement.

Finally, Kearsley considers CBT systems in terms of the ease with which they can be revised and updated. In general terms CBT has clear advantages over print-based systems. In CBT the need to republish and distribute books is replaced by the simpler task of replacing programme discs. In situations where many remote workstations are run from a central mainframe computer, a revision of the central programming will modify all CBT systems. The potentials for speed, responsiveness and cost reduction are quite clear. Given such transformative power, a long view might suggest that books are the product of an outdated technological form and as the new age of electronic media is ushered in, education will have to embrace the changes of approach and method that CBT offers.

Taken all together these arguments put a powerful case for the use of CBT techniques in education, but there are severe disadvantages associated with the medium, and any enthusiasm for existing CBT packages has to be tempered in the light of the known limitations of CBT applications. For instance, at a straightforward technological level Gindele and Gindele (1984, p96) are able to complain of the poor audio and visual capabilities of CBT. Visuals are restric-

ted to text or computer generated graphics. The latter are improving rapidly, but for the most part are crude attempts at pictorial representation. Audio signals are usually in the form of synthesised «beeps», and again rapid improvements have let to the generation of useful sound effects and even musical features, but the reality-effect that is associated with, say, tape-recorded sound lies beyond the capabilities of the medium at present. Going on from this, others have complained about the quality of many CBT programmes-poor graphics and sound are accompanied by simplistic and clumsy activities. Arcade game applications may become ever more fantastic, but educational programmes seem to lag far behind, leading Jarman (1986, p38) to complain of «the feebleness of computer software».

One of the mainstays of CBT courseware design has been the multiple choice question (MCQ). MCQs fit neatly into the CBT format because they allow for convenient branching and running of «sub-routines» as well as giving a quick and computable numerical score of a user's performance. In mainstream education, particularly in examinations, MCQs have been widely adopted. A debate has developed about their usefulness, and many of the points raised are of direct relevance to the utilisation of MCQs in CBT. Laurillard (1987, p88) argues that MCQs are «pedagogically unsound» for two main reasons. Firstly, they encourage straightforward guessing, which must be qualitatively distinguished from Clark's tentative acts of imagination. An incorrect guess is a pointless proof of ignorance, and a correct guess gives the illusion of success and understanding. Student vernacular refers to MCQs as Multiple Guess Questions! Secondly, insorfar as MCQs are forced to offer a range of choices by their very form, they encourage students to spend a significant amount to time thinking about wrong answers. And because the wrong choices have to appear plausible, they are often pitched very close to the right answer and can thus create uncertainty and confusion for students whose understanding would otherwise be clear.

Habit, ease and cost-effectiveness have led to the extensive use of MCQs in CBT and the whole medium has become discredited as a result. With more thought and programming skill, other more sensitive interactions could be developed, and CBT could mature into an excellent interactive learning medium. Laurillard's description of the Teddy Bears Disc was referred to at the end of Section One, and

the nine modes of interaction mentioned there are all applicable to CBT in general, and MCQs are conspicuous by their absence.

Laurillard (1984, p14) has also complained of other patterns of programme design that are prevalent in CBT. There is an implicit question in the use of any educational technological form of who controls the process and, ultimately, the nature of the interaction. In CBT it is possible for the computer to exercise total control of how students progress through a course, which parts of the training they will receive in what order, thereby denying students knowledge of where they are «inside» a course, how much they completed, how long it will take to finish, and so on. For Laurillard, this is a «gross misuse» of the medium. It restricts access to parts of programmes and therefore diminishes the use to which the total data can be put. It undermines the responsibility of students for their own learning - recreating at a stroke the passivity that CBT was intended to counter. In a modern political sense the power that the withholding of such information represents is undemocratic in spirit. In addition, Laurillard suspects that informed and enabled users are likely to learn more effectively. Early experiments referred to in her work (ibid, p14) lead her to conclude that students enjoyed control and were able to cope with programmes that required them to exercise control over sequence, route and pace of learning. Again, it is important to emphasise that the question of lack of control is one of conventional practice, rather than a fixed property of the medium itself.

One final criticism of CBT is that it is an isolated and isolating educational form. The educational benefit of peer contact, and the advantages of testing and sharing knowledge in groups is severely diminished. Taken to a logical conclusion, a situation could be envisaged where people related more easily to machines and developed as nothing more than an expression of the machines that socialised them - such an extrapolated view of a Brave New World of trained and pliant citizens is, of course, fantastic in the extreme - but it does serve to emphasise the impersonal and potentially de-humanising nature of CBT. In real applications, CBT would only form a small part of curricular activity and human compensations could be sought elsewhere. But educators are aware of this problem and have offered solutions. Rushby (1987, p128), for instance argues that CBT (and interactive video) could be used in classes or groups to «trig-

ger» discussion of issues. The machinery would provide source material and decision moments, but the learning would take place in a human setting of group-work or tutorial. Indeed many educational simulations, especially those in the humanities, already adopt this form - and computers are used to give a data flow of farming in a third world economy or running a business, whilst discussion and decision-making take place in class.

This Section has argued a case for individualised and interactive learning media. The key educational technologies have been appraised and have for a variety of reasons been found wanting. Computers have emerged as a potentially powerful educational tool, that carry the promise of effective interaction and individualisation, but at the same time the technology is limited or mistakenly applied in crucial ways. Interactive video is a combination of two of the forms that have been discussed ,and the next section will explore the benefits of the synthesis of computer and video technologies.

SECTION THREE
The Potential of Interactive Video

This section will explore the advantages of the composite technology of interactive video. General characteristics and applications of the form will be discussed and specific illustrations will be offered wherever possible. A case study based on the application of interactive video in language teaching will draw the strands of the argument together, before some problems of the new medium are examined. The section will end by suggesting some guidelines that relate to the choice of interactive video in educational settings.

In the previous section, an appraisal of educational media found strength in many but limitations in all. A model of learning was employed that emphasised the individual and the active dimensions. An implicit notion in the use of this model was a quest for a medium that combined the best expository capabilities, to meet the receptive needs of students, with the best inquisitory capabilities to encourage students towards active learning.

Mably asserts that «the televisual medium is now a far more informing experience than books» (1987, p184). Whilst this remains a controversial view, there can be no doubt that the powers of situational sound and realistic movement make television a compelling

medium. Educational method is still rooted in literary rather than televisual forms, but some argue that new electronic media will displace print media to become. The main information storage systems across the globe. (Postman and Weingartner, 1971, p155-162). If this is even partly true, then education has a responsibility to embrace the new forms and promote electronic literacy. In any case for many people broadcast elevision represents a primary information source, and as a result people are used to the high-engagement level that television achieves and other media can appear pedestrian by comparison. No other medium can approach the expository power of television, and yet television hes been seen here to have no potential as an inquisitory medium. On the other hand, a strong case has been argued for computers as a prime inquisitory medium, but the severe limitations of audio and visual representation pose problems for its viability in terms of the richness of experience that it can offer as a basis for active learning.The videodisc is the technological breakthrough that offers up the possibility of a combination of the two technologies that, in theory at least get rid of the disadvantages of each and blends the strengths of both in a new medium that operates on a qualitatively different plane. The resultant technology is difficult to categorise: for some it is CBT enhanced by moving pictures and sound; for others it is video transformed by computing power into an exciting and flexible educational tool. Thus, for Clark interactive video delivers the key factor of «subjective time» to the learning process, and as such is an enhancement of a video image system:

> «Not only the pace of the interaction, but also its trajectory, is entirely determined by the learner. In this way the maximum scope for individual imagination is provided in a way that is responsive to the particular train and pace of thought». (Clark, 1987, p69)

From this point of view the new techology is a straightforward improvement upon orthodox video. «It adds the crucial learning elements of activity and subjectivity to television viewing» (Hart 1988, supp iv).

Butcher (1987, p47) emphasises the capability of interactive video to upgrade CBT systems. He cites Macdonald's three paradigms for CBT, and concludes that each is made more effective in an interactive video system. Firstly, CBT is «instructional» and the addition of a video facility is a considerable aid to presentation, task setting and the motivation of students. Secondly, CBT offers a «re-

volutionary» paradigm, wherein simulation programmes are intended to encourage intuitive understandings. Butcher considers business simulations and remarks that «if during the game the company's managing director appears on screen asking for either improvements or resignation, the motivating effect can be imagined» (ibid, p49). Thirdly, CBT's «conjectural» paradigm permits the development and testing of hypotheses. For instance, students may be required to test models of the behaviour of structures under stress. Interactive video could replace the representation of such tests by computer generated graphics with «real» film of structural behaviour. The capabilities of freeze-frame and slow-motion add dimensions of observational science that are just not possible in CBT. Furthermore, the capability to overlay computer graphics on any video material allows models to be developed, tested and demonstrated in quite new ways.

In each to these paradigms, interactive video outperforms conventional CBT systems, and even offers completely new ways of addressing educational problems. Butcher goes on to look at the nature of student interactions in CBT and interactive video. Across a range, from simple recognition tests to the development of «constructive understanding» (ibid, p54) in an open-enquiry environment, interactive video offers the greatest potential. Butcher concludes that these strengths of interactive video derive from the fact that it offers «the widest range of features of all educational technologies» (ibid, p58). Earlier, Griffiths, use of Copeland's model for message systems was employed to appraise educational media. It can now be seen that interactive video is the only medium that has the capacity to cover all dimensions of the model. In video mode it is almost as transient as broadcast television, and yet allied with a computer printing facility it is as static as a book. As a store and display medium, encompassing maps, charts, photographs, text, sound and moving film, it is a comprehensive expository system. And as an enhanced from of CBT it is an excellent inquisitory medium that fully exploits the advantages offered by individualised and self-paced learning systems.

In Section One the possible applications of the new technology were mentioned. Now that the strengths of the medium have been argued, it should be possible to consider educational application in more depth. The development of the technology is at an early stage, so many of the applications suggested remain putative rather than

real - but where real examples exist, reference will be made to these. However, the state school system in Britain, will not bee the first area of society to benefit from interactive video applications. Many of the examples are drawn from corporate and public initiatives, and the relevance and impact of interactive video in education has to be inferred.

Interactive video has been shown to be a huge and flexible data storage system, and in educational terms the technology can offer, in new ways, the facilities of a library, or more specifically of an encylopaedia. The qualitative improvement on print-based systems is easy to demonstrate - the 43 million words and 24.000 pictures in the Encyclopaedia Britannica would fit easily into 30 minutes of videodisc space. What is more, the advanced indexing and cross-referencing techniques that are available to computers allow for speedy and creative management of such huge databases:

> «... the data-density, ease of searching, automatic cross-referencing and the ability to mix text and pictures come together to suggest a very powerful resource». (Clark, 1984, p192)

The US National Gallery has all of its painting on one disc (Dowling and Camstra, 1987, p147), and this opens up the possibility of interactive tours. Johnson (1987, p29-31) develops an imaginary tour to show what this might mean. A user might choose to view American landscapes; might further specify the theme of, say «Autumn»; might find a particular favourite and then call up text information in the forms of criticism or biographical details of the artist. Early sketches for the final work may be available and a new and unplanned course of enquiry may follow.

> «You are in control of this experience, easily creating your own learning environment. You decide what and how you want to learn. You decide how long you can spend learning. The system adapts to your demands, guiding your experiences but never limiting them, even if that means leading you to external references». (ibid, p31)

There are two educational applications that can be envisaged that stem directly from this encyclopaedic capability. Such vast storage power means that comprehensive and authoritative discs could be developed that relate to particular school subjects. The vast and accessible banks of pictorial data would greatly enrich a classroom environment. Just «one videodisc per curriculum subject could enormously enhance the teacher's classroom resources» (Laurillard, 1983, p36).

Beyond this, cross-curricular or theme discs could address topics such as, say, travel or the home to provide a rich background resource, tailored to different levels or disciplinary approach by separete use of the two soundtracks. The technology would speed the transformation of a school library from a store of books into a flexible learning resource centre.

Distance education programmes often rely heavily on technological mediation. Recent technological advances have ushered in new practices. Video material has become much more heavily utilised, and the Open University has begun a pilot scheme to monitor the potantial of course provision linked to domestic microcomputers. Against this background, the prospect of distance learning through interactive video systems comes into view. Vast amounts of data and courseware can be held on a handful of discs. The careful organisation of the siting of, and access to, remote work-stations could extend the availability and quality of distance learning materials by a huge factor. The videodisc is «a large quantum step from the existing methods of supplying education at a distance» (Clark, 1984, p192).

The power and relevance of CBT as a medium for simulations has already been discussed, and the enhancement that interactive video can offer to simulations has been mentioned. Again, the improvement is qualitative, rather than of just degree. A welding simulation might for example turn the television monitor into a horizontal plane to represent the workbench. A spatially sensitive device linked to the computer would represent the welding torch, and videodiscs would show the weld in progress. The speed and flexibility of the system is such that the simulated weld would feel «real», and the process could be gone through until a mastery was achieved - then practice with dangerous and expensive materials could begin.

Megarry (1987, p60) offers the example of the Interactive Science Laboratory disc ,published by John Wiley, to show the advantages of simulations on videodisc for schools. The disc allows experiments in gas chromatography, distillation, electrolysis and AC circuitry without the associated costs and danger. Experiments progress with a televisual realism towards a variety of typical outcomes. When it is considered that gas chromatography equipment would cost in excess of £15.000 the advantages of high quality simulations are obvious.

Corporate trainers have been quick to capitalise on the simulatory power offered by interactive video. British Steel spent £15.000 to produce a disc that deals with the handling of huge steel coils ait its Gartcosh plant. Real «on-the-job» training is not really feasible and would be very expensive in any case. The simulation permits workers to encounter all sorts of situations and decision moments in a very realistic way. The disc provides a safe, cost-effective and viable medium for training

> «If increased efficiency saves even a single steel coil from the scrapheap, it will pay for itself». (Megarry, 1985, p60)

By using interactive video, simulatons can be produced beyond the realms of physical process. The reality effect of the televisual medium allows for compelling simulations of human behaviour. This facility opens up the possibility for the exploration of social settings, where the branching structure of the disc can be used to present a number of routes through a siuation. In the realm of health and safety at work Shell UK's disc entitled «Slips, Trips and Falls» (Megarry, 1987, p60) gives an idea of what is possible. A range of typical working situations on rigs are presented in video sequences. Learners are able to study the circumstances and «eavesdrop» on conversations. At any time, in the role of Safety Officer, they are able to intervene in the course of a developing incident. They may help or exacerbate the situation and the consequences of their interventions are shown in subsequent video sections. The result is a seamless portrayal of sauce and effect that allows rig safety to be taught in advance of visits to the rigs themselves.

Television allows for the minutes of social interaction to be presented. The ability of interactive video simulations to capture facial expression, body language and paralinguistic elements of speech enriches social simulations. Lloyds Bank uses interactive video in 1.500 branches to train over 2.000 cashiers each year. The training moves beyond job processes into the more subtle concerns of relationships with customers (Griffiths, 1986, p216). The skills of successful interpersonal communications are at a premium for doctors in diagnostic situations. It is difficult and insensitive for medical students to practice these skills on real patients in real situations. As a result the human dimensions of patient handling are often left to chance. Griffiths (ibid, p216) reports that a disc is under development that allows students to practice diagnostic rountines. The sys-

tem will respond to voice instruction to add further to the plausibility of the situation.

For several years the possibilities of computer-aided diagnosis have been explored. Interactive video is able to offer a further refinement of the technique. Typically, a system asks a series of questions: progressing steadily through all possibilities - narrowing the range - and finally delivers a printed on-screen diagnosis. In one disc-based system a similar pattern is followed, but if a doctor requires explanation of a particular decision or diagnosis - or wants to know the relevance of a particular question - the system switches to video mode and offers an explanation in a televisual form (Smith, 1986, p76-79). In all such examples the paradox, that highly technical educational forms are delivering a more engaging and human quality of tuition than was achievable by previous forms, is apparent.

This «human» quality has been exploited by the local Government Training Board on a disc intended for use training of bus crews (Rushby, 1987, p116). The disc is a good demonstration of interactive video's potential as a medium for the development of interpersonal skills. The video material is «shot» from the driver's viewpoint on a one-crew member bus, and takes the form of encounters with a variety of passenger types. At appropriate moments, where a driver would be expected to speak or take an action, the video freezes and a menu of options appears. The disc is intended for use in a tutorial setting, and so a tutor-led discussion explores the options open to the driver. At any time an option can be selected and the consequences of a course of action can be realised in a further video sequence, which in its turn becomes the focus of discussion. Outside of the tutorial setting, the system has been used in bus crew canteens for independent study.

This disc shows that interactive video use is not limited to isolated individuals, and that the technology can usefully support group situations where the contribution of peers is seen to be of value. Rushby suggests that such a use of discs to «trigger» discussion in a controlled environment represents a productive half-way house between linear video and full interactivity (ibid, p116).

Many of these examples do derive from industrial and commercial applications, but the relevance of such developments for schools and colleges is clear. Mainstream education needs to keep abreast of developments in the broader society. At a more concrete level,

the progressively greater involvement of schools in vocational education will lead to a need to utilise appropriate training methods. At times no clear distinction between vocational training and pure educational concerns can be maintained. Plummer argues a strong case for interactive video as an ideal medium for the in-service training of teachers. He points out that the high storage capacity and the computer-based index systems would allow teachers to

> «... experience, study, review and discuss practices, methods, approaches and techniques being used elsewhere in the educational system». (Plummer, 1985, p246)

In his view, interactive video could transform existing practice and deliver in-service training for all teachers, all the time on a continuing basis.

There are other applications of interactive video that draw on a training perspective and yet have clear educational potential. Mably (1987, p201) suggests that any craft skill or any example of excellent practice in any discipline, could be usefully held on interactive video disc. From metalwork, through art, to sport - the potential and sheer demonstrational power of interactive video is apparent.

Demonstration is only one of the many uses to which interactive video can be put, however. Each application seems to bring out new qualities and new possibilities for the medium. At times, the only limit seems to be that of the imaginations of the design team. For instance, Meggarry (1985, p60) refers to a programme that assists in the teaching of language acquisition to deaf pupils. The potential impact of interactive video in all sorts of special education programmes can be well judged from this example. Chris Jones of Donaldson's School for the Deaf in Edinburgh has developed a system that uses commercially available videodisc material, but uses the computer facility to stop or slow down the video sequences. Over the video, computer generated teletext is used for subtitles, summaries and other prompts. The system has its own conventions, which are quickly learned and utilised by pupils. The sub-titles use colour to stress the tense of a verb. This is emphasised by using frozen images to denote past tense; moving images for present tense, and a black screen, which indicates that action is yet to occur, for future tense. The system is complemented by a «video dictionary» that allows words to be pointed out with a screen cursor, thereby triggering a pictorial demonstration. It can be seen that the two tech-

nologies of video and computer have been put in harness to do what neither could have done alone. The combination has created a new and exciting resource for teachers in this special area of the curriculum.

Any tardiness in the adoption of interactive video techniques in education will not be because of a lack of potential applications. The relative scarcity of interactive video in mainstream education will be explained in Section Four, when what might be called the political economy of interactive video will be discussed. For now it need only be noted with what speed other agencies are taking up interactive video methods. Ford and General Motors in the USA already use over 15.000 videodisc players between them, and it is estimated that by 1993 the US military will be using almost 50.000 videodisc players for training purposes (Griffiths, 1986, p216).

In order to bring the disparate lines of argument that have been used here to explain the potential of the new medium, it may be worth looking at one application in some detail to see how earlier media are outperformed by interactive video. Bates and Hill (1985, p28) have written about an experiment to apply videodisc to the teaching of languages in schools. They were able to draw positive conclusions about this specific application, as well as demonstrating the general strength of the new technology.

> «Interactive video for language teaching presents teachers and learners with an opportunity to make a real breakthrough in harnessing technology to stimulate effective learning». (ibid, p28)

They base this conclusion on extensive experience of both video and computers in classroom situations, and they offer an analysis of the value of each medium. They see considerable value in the use of television in language teaching. It offers high engagement, and motivates students towards learning. Television is able to show language in action, as it conveys all the paralinguistic detail of spoken language. Through television, language can be demonstrated in proper cultural contexts, and an almost limitless number of native speakers can be brought into the classroom. All in all, television is able to offer up authentic speaking and listening situations.

Bates and Hill also see the computer as having a unique and valuable contribution to make to language teaching. Computers are endlessly patient, allowing individuals a flexible environment for

drill and practice. Good language programmes can correct, control and guide a learner without forcing the learner no break concentration on language use. Furthermore, computers are able to offer specific individual feedback that is automatically tailored to the needs of each learner. For teachers, computers have the advantage of being able to offer intensive monitoring individual performance. Individual problems can be accurately spotlighted, allowing teachers to use their energies efficiently. If required, computers can produce comprehensive learner profiles that can be used for the planning of future lessons and for remedial interventions.

However, both of these media have considerable limitations that can frustrate and disable classroom initiatives. Video is often awkward to use in class. The operation of the machine, with poor freeze-frame capabilities and slow, noisy tape winding, intrudes on the learning process. Learners are used to the polisheed flow of broadcast television and find such interruption unacceptable. By the same token, however, the unarrested flow of a video programme can sail over a learner's head. A private retreat into boredom and daydreaming is not necessarily noticeable. Video offers the same message to all learners at the same time, regardless of need. By its nature, it offers little individualisation of content for language learners.

The computer is also a less than perfect medium for the teaching of languages. Current systems are based on the use of text on a monitor screen. Such systems do not offer authentic spoken material, and are unable to provide oral practice. This bias towards written language rather than the spoken word is at odds with the current pedagogy of language teaching, where correct grammatical style is expected to grow out of language in use, rather than drill.

Bates and Hill move on from this critique of the separate technologies to consider their value for language teaching when they are combined.

> «... when video and computers are linked to form an interactive system, the advantages of both media are preserved and the disadvantages largely disappear». (ibid, p28)

In their view interactive video offers real language use in authentic situations. The televisual material is highly motivating but in the new format it is enhanced by being finely controlled and individually targeted. The results of their field work are «conclusively in support of interactive video» (ibid, p28). They report that learners are enthu-

siastic about the system, and that learners sustain a high involvement with language programmes. Learners had little diffucilty in handling the system, showing a clear understanding of tasks and processes. Bates and Hill claim that the interactive system encourages a higher oral response than other media. Further, they estimate that students acquire more vocabulary through interactive video than they would in the same time using other media. They conclude that for the purposes of language teaching interactive video is consistently more successful and more efficient than orthodox video. Interactive video brings to language teaching «a successful and enjoyable learning experience, clearly supported by the learners themselves» (ibid, p28).

The above case study presents a strong case for the application of interactive video in everyday educational settings. The theoretical appraisal of educational media seems to be supported by field tests. Furthermore, the claim that interactive video is a qualitative improvement on previous forms appears to be borne out. For all this potential, however, there are already drawbacks associated with the new medium. This section will move towards a conclusion by airing some of the acknowledged limitations of interactive video and by providing some quidelines for proper application of the form to educational problems.

There are several pitfalls associated with the new technology. Firstly, the highly technical nature of the technology, that requires both technical know-how and enthusiasm, can deliver interactive video into the hands of technicians and away from educators. It is, of necessity, a technologically driven development. There is a danger that developments will stem from a desire to explore the new medium rather than from any analysis of needs. In other words, the focus for design may become the medium itself, rather than the instruction. Laurillard is aware of this tendency for development to be steered towards technical concerns, and she complains that many early applications have been «disappointing from a pedagogical point of view» (Laurillard, 1987, p12). There is an irony here - the whole point of technological innovation is to aid the enterprise of teaching, and yet the innovations may carry forward and amplify poor educational practice. Interactive video programmes can only result from elaborate teamwork, and educational theory can easily be submerged by the demands of other specialists. At a minimum interactive

video production needs a subject expert, a systems analyst, a video producer and an instructional designer. These roles need to be supported by technical staff - programmers, graphic designers, camera operators, actors and so on. The question of who retains overall control is a delicate one, and it may be difficult to keep a clear view of educational goals.

A second pitfall of interactive video also stems from the complexity of the technology. Non-specialists who are nevertheless keen to utilise the medium may find themselves tempted to use the ready-made devices that are designed to ease production problems and put interactive video into the hands of the layperson. Instead of programming a system from scratch, it is possible to use a «friendly» package that removes much of the need for specialist computer knowledge. Such a package is called an authoring system, and several are now commercially available. Laurillard (ibid, p13) is highly critical of such systems. The removal of technical problems would appear to be a positive step, but authoring systems invariably remove pedagogic control too, as they only offer a limited number of ways of using the medium. The situation is exacerbated by the fact that, they are often designed by people with previous experience in CBT, and so carry forward an over-reliance on multiple choice questions, the consequences of which have already been discussed. Thus, to some extent the early history of interactive video one of misapplication and poor design, leading Bork to conclude that «much of what has been produced so far might be best decribed as slightly interactive video» (Bork, 1987, p28). The routines of technical design underuse the full capabilities of the medium, yet it is difficult to see how practicing educationalists can develop the mastery that is required for proper, informed application.

A third difficulty is centred on the gulf between educational practice and technical expertise. The new medium is said to be a total and powerful medium for education. It is fast developing a reputation as a «cure-all» for educational problems. Expectations may move ahead of what is realistically attainable. Interactive video may fail to offer instant solutions and offer instead the need for hard work and experiment along untrodden paths of demiated education. The result may be that interactive video will provide many teachers with unwelcome problems, rather than the assistance that they are looking for. There is a thin line between imaginative plans for application and quite unrealistic hopes for the medium. The former is

based on a proper appraisal of the potentials of the form, the latter, probably, is not. The result could be a disenchantment with the medium and a failure to make sensible use of its unique capabilities. Laurillard sounds the warning in these terms.

> «Practitioners must expect that no matter how much the potential of the technology beckons, the constraints it imposes will always curtail their most imaginative ideas». (Laurillard, 1987, p144)

Finally, at a more everyday level, Laurillard (1984 (ii), p607) has considered some of the difficulties that may arise in the attempt to establish interactive video as a part of a learning programme for students. The simple fact that students would have to travel either from home or across a campus or school could deter some students. Interactive video is likely to be offered as an addition to compulsory classroom sessions - students may treat interactive video as an extra that can safely be ignored. If interactive video is made part of a resource centre provision, then uptake may be poor as many students show a deep reluctance to use such facilities to the full. Interactive video does not match the needs of the «minimalist» student who sees education in terms of lectures, set books and essay work. The only way out of this dilemma is to utilise interactive video as an integrated part of the curriculum, which probably creates more diffuculties for educators than the educational concern that led to the choice of interactive video in the first place.

At this early stage of the evolution of the new technology, the prospects of broad and rapid application are severely hampered by the limitations outlined here. Furthermore, this discussion has been restricted to the consideration of systemic limitations that are a part of any technologically determined developments. There are far more problems of a financial and institutional nature that affect the utilisation of the technology - these will be explored in the next section.

It can reasonably be assumed that the difficulties pointed out here will not totally remove the incentive to establish interactive video programmes in schools and colleges. Therefore the questions remains - when should interactive video use be considered? Throughout this discussion the power of interactive video to promote learning through learner activity has been argued. Fuller (1987, p16) suggests that this is a good basis upon which to judge whether or not to use the new medium. If it is reckoned that interaction with a video image would improve a learning environment, then interactive video

seems to be a proper choice. Further, when compared to other media, interactive video should be seen to increase a student's active learning. If this is not the case, then there are probably cheaper and more easily actioned alternatives available.

These general considerations may encourage the choice of interactive video. However, Laurillard (1984 (ii), p607) suggests a range of other conditions that have to be met before any deployment could have a proper chance of success. In the first place, interactive video should offer something that no other medium can match. Even where exciting use could be made of interactive video, it doesn't make much sense to get rid of successful practice. Furthermore, interactive video should be targeted where there are high numbers of potential users. Costs need to be spread in order to achieve an economic justification.

Interactive video will stand a better chance of success in environments where resource centre use is encouraged and has become part of a normal study regime. Similarly, there should be scope for the provision of an adequate number of work-stations. Otherwise the danger exists that interactive video will only achieve the status of a sideshow or gimmick. In general terms interactive video probably needs a sophisticated and aware institutional setting, if it is to thrive. Interdisciplinary course teams may be needed if course material is to be designed and produced. Evaluation and testing of such materials needs to be given a central role to play. The use of interactive video requires a commitment to staff training so that proper skills can evolve with the technology. Technological advance will bring greater simplicity, reliability and lower costs to systems. Wherever possible, tried and tested systems should be adopted, even if this incurs a delay in adoption of interactive video techniques. Finally, Laurillard makes the sensible point that for success the technology needs to be acceptable to the specific type of learners involved. If learners are daunted or overwhelmed by a system the chances of effective learning are diminished

This checklist of considerations is broad in scope. Laurillard's perspective moves from the details of student use through to the more general concerns of institutional support. As such her comments serve as a useful bridge between this section and the next. Here the full potential of interactive video has been explored, and the argument has drawn on real and imagined applications. Interac-

tive video emerges as a powerful medium that could have a profound effect of educational systems. What has been glimpsed here is the potential of interactive video

> «... to change radically patterns to teaching, learning and communicating». (Megarry, 1987, p60).

However exciting it may be to consider the impact of the technology in the abstract, the fact remains that it is in the immediate context of schools and colleges that the future of interactive video will be determined. It is to the economic and institutional constraints on the development of interactive video that discussion must now turn.

SECTION FOUR
The Political Economy of Interactive Video

Potentials can only be realised in actual commercial and institutional contexts. Any estimation of the impact of interactive video has to take account of the nature of the school and college system in Britain and other countries. It is within this particular framework that interactive video may come to have an impact that is «without precedent» (Megarry in Mably, 1987, p193). On the other hand, interactive video may remain beyond the reach of teachers and learners in everyday situations

> «For all its potential flexibility and effectiveness, it may simply be another revolution which does not happen». (Hart, 1987, p187)

In this section the determining nature of the commercial and institutional framework will be discussed.

Some commentators are already suggesting that the development and application of interactive video are not progressing as fast as they might. Potential is acknowledged, but interactive video «has not enjoyed the realization of that potential as quickly as was predicted» (Johnson, 1987, p30). Any institutional explanation for this has to include consideration of global economic, political and social history. For instance, the video disc player has enjoyed little success in the commercial market-place in Britain. Consumers have turned instead to VHS tape systems, and so manufacturers have directed their energies accordingly. As a result, the ownership and, therefore, the recognition of the potential of videodiscs remains very low, in short, local circumstances have provided no infrastructure for the easy development of videodisc systems. This situation is in mar-

ked contrast to that pertaining in both the USA and Japan. In the USA the rise of the domestic video tape player has been slower and less significant. The larger training and educational sectors have called into being a small training industry - and the adoption of videodisc systems has been relatively rapid. Mention has already been made of the fact that two corporations and the military will soon own almost 65.000 videodisc players between them. In Japan, both domestic users and trainers were enthusiastic about videodisc from its introduction. Over 250.000 domestic videodisc players have been sold, and it is estimated that a total of 500.000 players are being used by industry (Mably, 1987, p198). These figures demonstrate an infrastructural soundness, upon which further developments can take place with relative ease. Purpose made discs are already commercially available to schools in Japan. Whilst these discs may not be for fully interactive use, it seems to suggest that the development of interactive video would be relatively simple. This contrasts with Britain where a tiny domestic sector is matched with some patchy uptake in industry and hardly any penetration of schools and colleges, other than in research.

To date the only encouraging signs of substantial development in interactive video comes from training applications in commerce and industry. It is possible to give account of the relatively rapid growth of the medium outside of schools and colleges. Hart (1987, p174) argues that there are five factors to consider. Firstly, training often takes place in enterprises where there are large numbers with the same training needs. Costs per unit are thereby minimised and higher start-up costs can be considered. Secondly, trainers are often faced with a geographical dispersion of those with a training need. Distance learning strategies are therefore central to the effort, and the employment of technologically mediated training packages is likely. Thirdly, a typical training environment will generate new training packages almost from scratch. Capital items and specialist tutors will be bought or hired as required. The core establishment of full time training staff often remains small and centralised. Thus, by comparison with mainstream education fixed staff costs are low and a higher proportion of a total budget can be creatively deployed in each new application. Fourthly, this flexibility in the training environment allows for accurate budgeting and costing of provision - outcomes are directly related to expenditure in ways that are not often possible to determine in education. Trainers are therefore

free to choose the right medium for any task and have straightforward means of arguing an economic justification. In education, costing cannot be done with such accuracy. The standing costs of staff and buildings are often a key concern and innovation can become marginalised. Finally, training has tended to make more use of the early technological form of CBT, and as an upgrading of CBT facilities, interactive video has an obvious and straightforward appeal.

The situation in education is different. Local financing, departmentalisation and specialisation tend to divide the total student population into small and discrete compartments. Economics of scale are, therefore, often difficult to identify. Distance learning, whilst growing, is a minor part of total educational enterprise. The main thrust of education has always been, and still is, to bring people to a central provision. The need to disperse education is not intense enough to maximise technological innovation. Most crucially, educational provision is labour intensive, and this has a powerful determining effect:

> «When costs are closely related to the payroll, and where staff tenure may exist, it is simply not feasible to shift investment from one kind of resource (staff) to another (learning machines and materials)». (Hart, 1987, p175)

Furthermore, CBT has not been widely utilised in education and so the rationale that supports the development of interactive video in training is not present to the same degree in education.

This pessimistic view of the institutional backdrop of education suggests an inertia that is likely to hinder innovations like interactive video. Indeed, Hart suggests that a professional resistance, based on an instinctive, defensive conservatism, has to be reckoned with.

> «Resistance to new practices tends to continue for as long as possible until statis begins to look more dangerous than movement». (Hart, 1987, p176)

If this is the case, then estabilshed modes of learning are likely to be well-rooted. The opportunities for interactive video may be restricted to margins where the dominant view of education as timetabled teachers in classrooms does not hold complete sway. It is interesting that the Open University, modelled upon a different educational approach, has proved to be a prime mover in the development of interactive video techniques.

In any case, whatever timidity institutions show toward innovations like interactive video, there is a strong rational case for being cautious. However expressed, the costs of interactive video are not low - this simple factor will discourage many making expensive, irrevocable commitments to the technology. Moreover, unless users are totally committed to producing all of their own interactive material from scratch, which is unlikely, they will necessarily be forced into a surrender of some autonomy over programme content. Established, home-grown practices are likely to be preferred over the more expensive materials offered by the new technology that have originated in outside agencies. In addition, high capital commitments do create an inflexibility - such investment has to be justified by regular and sustained use. Traditional forms of classroom presentation and «handouts» are cheaper and more flexible. What is more, any new technology may be prone to unreliability. Also the lack of a wide range of courseware, i.e. discs, is likely to prove to be a major disincentive.

There is a difficult «Catch 22» situation here (Laurillard, 1983, p36) that has its origins in the commercial nature of interactive video development. On the one hand, schools and colleges may remain sceptical about investing in interactive video, and may be discouraged by the lack of commercial software. They may prefer to wait until such a time when the investment can be justified on the basis of broad application. On the other hand, producers and publishers of software cannot commit themselves to a wide range of disc programmes, because no significant market is yet in existence. The need for a proper return on investment does not allow for speedy development. Mably (1987, p197) puts this well when he says that the lack of a mass market leaves little scope for commercial profit, this in its turn discourages investment, which arrests the development of a mass market.

The proper development of interactive video is also affected by the fact that the commercial environment is a competitive one. As has already been explained two videodisc systems are vying for dominance, and this is bound to increase nervousness and confusion for educators. Potential users may delay decision; the issue of technological form may stay unresolved, and the whole future of interactive video may be made less secure.

«...a chaotic lack of standardization could kill this exciting new development stone dead before it has a chance to get off the ground». (Fox, 1985, p53)

The gloomy prognosis that these comments represent can be tempered by the consideration of the following arguments. Firstly, the increase of interest in interactive videodisc may spur the emergence of interactive videotape as a less sophisticated but affordable alternative. Such systems, which have already been mentioned, only require an institution to purchase an interface in order to put existing hardware of players, monitors and computers to interactive use. White reports that research in this direction under Brighton Polytechnic's Telsoft project is now yielding commercially available results (White, 1987, p70). The Fruther Education Unit have reported favourably on tests of low-cost video-tape based experiments utilising both pre-existing and specially commissioned video material. They report the popularity and effectiveness of the new medium, but caution that even at this budget end of the market cost-effectiveness depends on the extent to which packages are used (FEU, 1987, p13-20). Exploration of affordable tape-based systems does offer up the possibility of breaking through the high cost/poor availability barriers that are associated with videodiscs. Mably suggests that tape-based systems represent the «Model T Ford» of interactive video, insofar as they represent a sensible and affordable alternative to the «Rolls Royce» of videodisc (Mably, 1987, p204). For Mably, the adoption of tape-based systems could encourage a steady institutional change, from the bottom up. He considers such a path to change as having a greater chance of success than high-cost disc technology, which strives for educational change «from the top down» (ibid, p203). Changes in institutional practice that would develop from a programme of tape-based interactive video usage may encourage a graduation to full disc systems at a subsequent date.

Secondly, as has already been mentioned, archive material held by organisations like the BBC and the Open University could be released on disc, thereby reducing significantly the high costs associated with video production. If discs of this material were published - and the commercial validity of such a move is increasing all the time - schools and colleges could develop their own computer to handle the material. This would further encourage a soundly based «bottom-up» approach to the medium.

Thirdly, early experience has shown that what are called «generic discs» are likely to have a broad appeal. Private companies may commision training discs in such a way that they are not limited to a specific corporate use. For the company, the offering for general sale of a disc raises revenue and offsets costs. Many applications are possible within a «generic» formulation. There is no reason why the discs that are produced for training, such as, say, discs on telephone technique for personnel management, cannot have wide application. Indeed such discs would usefully straddle the divide between industry and education. The possibility of customising generic discs to local need by developing new software is a useful feature that would secure the autonomy of each user.

Fourthly, there are indications that producers and publishers are coming to see videodisc publication as viable. The BBC's «Volcanoes» disc and John Wiley's «Interactive Science Laboratory» are in existence and are available to schools now. The required momentum may be slowly being achieved. The BBC in particular, in the wake of their Domesday project have commissioned much pioneering work. They have recently added «The Ecodisc» to their list of publications, offering a taste of life on a nature reserve in Devon. These discs will be more fully discussed in Section 5. With each publication the temptation for schools and colleges to become involved is increased.

Finally, it could be argued that the way to cut through a commercially generated hiatus in the development of interactive video is for government to subsidise educational initiatives. If government were to prime the pump, then the engine could soon come to run by itself. Current government policy seems to be acutely aware of the potential of interactive video and money is being spent on its promotion. Government programmes will have a powerful determining effect on the emergence of interactive video in education in Britain, and these will be properly discussed in Section 6.

And so the issues surrounding the development of interactive video in Britain remain clouded. A barrage of arguments suggest that its future is severely limited, but other commentators see gaps in the clouds at every turn. Mably suggests that the innovation needs «vision, courage and money» (Mably, 1987, p197), and pessimists may wonder how much of these commodities is spare in British education. Johnson puts it another way, arguing that the constraints

to interactive video development are «money, markets and materials» (Johnson, 1987, p39). He offers a gradualist perspective wherein the costs will slowly come to be understood as worthwhile; where the markets for interactive materials will steadily grow, and where a «critical mass» of materials will become available for the healthy rise of interactive video in education. The cautious optimism that Johnson proffers is a product of the American situation. In a British context the scales may tip back towards pessimism. After all, Chambers argues that

> «...the recession, the heavy financial burden involved in disc production and increasingly stretched finances in education may conspire to frustrate hopes of interactive video reaching a broad secondary school audience within this timescale [the next five years].» (Chambers, 1987, p24)

Hart describes the situation in higher education in much the same terms. He is one of Britain's leading advocates of interactive video, but his hopes for the medium have to contend with an educational system that is typified by «declining income, rising costs and staff-student ratios and deteriorating premises» (Hart, 1987, p187).

The unique strengths of the medium have been argued here-perhaps the key to success is sensible and informed development. As Mably says

> «If the right educational needs are addressed, in the right way at the right price, educational videodisc should sell like hot cakes.» (Mably, 1987, p204)

The single biggest thrust towards the use of interactive video aid the classroom has been the BBC's Domesday Project. The next section will discuss this initiative in detail.