THE AUSTRALIAN JOURNAL OF

EDUCATIONAL TECHNOLOGY

Computer videodisc education systems

Raden Dunbar
Executive Officer
Satellite and Telecommunications Association

Introduction

Discussions about the likely widespread use of videodiscs in systems of educational technology have until now tended to focus on the fact that the present generation of disc systems are non-erasable. The grooves and pits moulded or encoded into the surfaces of, respectively, capacitive and optical videodiscs cannot be reconstituted as part of a re-recording process. Any alteration of program content or sequence involves creation of a new master tape from which a new batch of discs must be manufactured.

Educationists normally require an instructional medium which can be modified easily and cheaply in the process of regular content evaluations. The blackboard, for example, has this sort of flexibility. Thus far, the complexity and cost of videodisc reprocessing has been regarded as one of the major barriers to its future wide use.

However, the educational potential of videodisc is enormous, even revolutionary, as I shall elaborate in this paper. It enables computer directed delivery via television screen of alphanumeric, audio, graphic, still picture, and moving picture information randomly accessed from very large data bases. Depending on the design complexity of video and computer programming, this can be done in an almost endless variety of sequences and overlays. It combines in the one integrated system practically all print and nonprint educational technologies so far devised, and provides the foundations for a truly individualised random-branching system of interactive instruction.

The development, proliferation and refinement in the United States Japan, and Europe of new microelectronic devices for processing information is an industrial phenomenon which appears to have no bounds It comes as no surprise then to read of the May 1983 announcement by Matsushita Electric Industrial Company (O'Brien 1983:17: Williams, N. 1983:6) of a major breakthrough in videodisc technology the erasable, reusable videodisc for optical disc systems.

The surface composition of the Matsushita disc can be altered in a photochemical process involving crystalline change in a coating tellurium oxide/germanium/indium compound when this is exposed to laser light. The laser changes this compound from crystalline to non-crystalline or the reverse, and alters the degree of crystal reflectivity.

It is widely and confidently predicted that this photochemical disc will eventually replace all magnetic, capacitive, optical, and other electronic and electromechanical storage devices, and will enable even greater convergence of audio, video, and computing technologies. In data processing terms, it means the new videodisc will no longer be a read-only memory (ROM) device but will provide an expanded read/write memory capability. As such, its announcement represents another step towards the creation of a powerful and efficient technology-based system of teaching and learning which may one day supersede present instructional methodologies.

Convergent technologies

Richard Hooper (1982) has observed that convergence of previously discrete information and communications technologies is beginning to have considerable impact on advanced cultures. He cites the growing intermarriage of computing, video, audio, and telecommunications, and says that this is contributing to a rapid transition away from the industrial era. Marsh (1983:52) suggests that interactive computer-videodisc technology is the epitome of convergent technology and symbol of the post industrial society: it ushers in "high-tech customisation" of information, and may thus enable the "demassification" of society earlier predicted by Alvin Toffler (1980).

This paper is concerned with the convergence of video, audio and computer technologies into videodisc-based interactive instructional systems (or Time-shared, Interactive, Computer-Controlled, Information Television - TICCIT- as explained by Butler 1981:17). My objective is to examine some of the elements of these systems and my focus will be on computer-videodisc hardware and software and on some of the technical and organisational problems and procedures relating to courseware design and production. Although this orientation excludes detailed discussion of the human problems relating to such innovations, I freely acknowledge that these must prove to be an issue of overriding significance.

On that subject I shall say this: it needs to be remembered that convergence of technology is not limited to the physical integration of machines. It also involves a rearrangement of the human activity which is directly and indirectly linked to them. Even though the development of new machines is a complex business it is not nearly as complicated as changing the patterns of related human behaviour. The fact is that computer-videodisc systems come at a time when Australian educators are still trying to adapt to the generation of stand-alone videocassette devices introduced a decade age, and when they have just begun to adapt to the present generation of computing equipment.

Another human aspect of hardware convergence has been noted by Bejer (1982:78). he observes that the computing and communications equipment industries have achieved tremendous growth over the past two decades, but have developed, in the most part, unmindful of each other. The interfacing of video with computer hardware has largely been developed in an incidental way by "cottage" industries outside the mainstream of communications and computing. Bejar suggests, however, that this separate mating of hardware will be eventually followed by the wholesale coalescence of major industrial conglomerates such as IBM and AT&T to form a new information industry.

Computer-videocassette systems

As I have mentioned, videocassette technology has been available for a decade. At the beginning of the 1970s three-quarter inch U-Matic videocassette recorder/players began to appear in schools and colleges, and these were followed by a proliferation of videocassette instructional software. More recently, lower cost half-inch VHS and Betamax VCRs have begun their invasion, especially of primary schools and kindergartens previously denied easy access to video technology on grounds of cost.

It is true to say that very little video programming played through these systems is designed specifically for instructional purpose. Most videocassettes used by teachers are off-air recordings of broadcast TV, recordings of documentary or feature films, or in Some cases material prepared by teachers to illustrate areas of course content. Most commonly, video is used in the same way as projected media: it is shown to whole classes or groups, and its purpose is entertainment, illustration, or enrichment. It is adjunctive to face to face class teaching, and is typically regarded as an "audiovisual aid".

It is now possible to drive a videocassette player using microcomputer control. This means that CAI programming can be supplemented with video segments. In some cases this involves the use of two VDUs - one for computer generated information and one for video segments. In systems like CAVIS (Copeland 1983ab) a split screen is used to combine both in the one display. Various computer videocassette authoring programs are available, such as the McGraw-Hill Interactive Authoring System and these enable the construction of CAI programs utilising colour alphanumerics, graphics, and video segments retrieved by video control track indexing.

Computer-videocassette interface provides the means for constructing expanded-capability interactive, individualised CAI programs. Due to the very large numbers of videocassette players now in Australian schools and colleges, and growing microcomputer availability we may see increased interest in this type of instructional media.

I suggest that there are some obstacles to this (apart from inherent teacher resistance) which are not easily overcome. The design and production of programs can be a complex and time-consuming task and it is doubtful if sufficient human and other resources can or will be made available for experimentation or for building up a sizeable stock of courseware. Most cassette programming has not been designed for CAI interaction so that appropriate, clean edit points may be difficult to pick. As well, video access times in these systems are slow; still frame quality is poor and cannot be held for any length of time; and video quality deteriorates with dubbing and age.

However, computer-videocassette programming experience by teachers and educational technologists must be considered useful as preparation for later changeover to computer-videodisc as design and production procedures are much the same in both cases. The point is that computer-videocassette interface is not the same truly Convergent technology as is contained in computer-videodisc systems and must be considered only as a passing phenomenon.

The development of videodisc

It is appropriate at this point to briefly review the history of videodisc development. As Fist (1980 28), Fisher (1982:111) and others have recorded, this history goes back to 1927 when John L Baird engraved video signals on a gramophone disc in much the same what that audio signals were recorded. Baird's hard disc system was not improved on for almost forty years and in the meantime an efficient video recording medium was found to be the magnetic tape developed by Ampex and announced in 1956.

It was not until the 1960s that the modern videodisc system was devised following intensive developmental work by American and European companies including RCA, Philips, Telefunken-Decca, MCA and Thomson-CSF. By 1972 all of the videodisc systems currently used had been developed and were in place.

It took most of the 1970s for systems promoters to build disc pressing facilities, collect marketable titles, and establish marketing networks. In 1978 Philips/MCA began test marketing of the "Magnavision R" videodisc system, and since then there has been a flood of players and discs onto the North American, Japanese and European markets. More recently Japanese manufactures have entered the competition and the Pioneer VP-1000 player has become established as a market leader. As was the case with videocassettes there are a number of fundamentally different videodisc systems on offer and observers are now waiting to see which gains predominance.

Classification of videodisc systems

Clement (1981:15) and Onosko (1982:84) classify disc systems by signal storage/retrieval method. There are two primary categories, optical systems or capacitive systems, each with two sub-categories as follows:

1. Optical systems.

a. Reflective: this system uses an optical-tracking laser-pickup which reads the laser light reflected from microscopic pits encoded into the disc surface. Examples include Philips/MCA, Magnavox, Pioneer, DiscoVision Associates (DVA), and Sony.
b. Transmissive: an optical-tracking laser-pickup reads the laser light transmitted through the disc. The only commercial system of this type is manufactured by Thomson-CSF in France.

2. Capacitive systems.

a. Grooved: this system uses a diamond stylus pickup in physical contact with grooves moulded into the disc surface. Examples include the RCA, Zenith, CBS, and Sanyo systems.
b. Grooveless: a diamond or sapphire stylus follows electro-tracks implanted in the disc surface. Brands include JVC/Matsushita, GE, Quasar, EMI, and Panasonic.

In general, optically read discs have a capacity of 54,000 frames per side in standard configuration or 108,000 in extended play Individual frames and frame sequences can be accessed randomly and played in slow motion, freeze frame, frame-by-frame, or fast scan, all without noticeable picture distortion. The discs have unlimited life due to a protective resin coating.

Capacitive disc systems have a standard capacity of 108,000 frames per side, but only the grooveless system offers random frame accessing and multiple play functions. Lifespan varies from 300 play- hours in the case of grooved discs to 2,000 play-hours for grooveless.

So far the optical-reflective system has emerged as a market leader and with the previously mentioned development by Matsushita of an erasable optical-reflective disc the indication are that this system may become the industry standard. It is certainly the case that of systems so far reported in educational applications the optical-reflective consumer players produced by Pioneer (model VP-1000), and educational/industrial players produced by DiscoVision Associates, and by Sony (model LDP-1000) are preferred.

Optical-reflective videodisc system characteristics

Each of the 54,000 frames of information in the optical-reflective videodisc is contained on a separate spiral track and is addressed with a 1-54,000 frame number. When the disc is played at the normal speed of 30 frames per second two channels of high quality audio are available which can be used for stereo music, bilingual audio tracks, or to present commentary at two different levels of comprehension. The user can monitor either or both audio channels.

Any program segment on the disc can be randomly accessed by the inbuilt microprocessor with a search time of between 2 and 10 seconds. This means that the program contents can be arranged like a book and organised into discrete chapters indexed by a table of contents. For educational purposes stand-alone systems can be supported by optional index materials such as text or a visual data base built into the program sequence.

Both motion sequences and stills can be combined in the programming enabling the mixing of different types of media including films, filmstrips, videocassettes, and slides. Certain frames can be allocated for alphanumeric information and read in freeze-frame.

Without computer interface the system can be utilised for instructional purposes. Kemph (1981:648) has reported a number of programs produced by the Nebraska Videodisc Design/Production Group which use sequences of motion, slow motion and freeze-frame to illustrate actions, or which use the indexing/search capabilities for communication of encyclopaedic information. The "First National Kidisc" described by Blizek (1982) contains considerable educational programming utilising program-prompted/learner controlled multimotion and freeze-frame, as do numerous "how to" discs presently appearing on the US consumer market. In the latter case, numerous cookery, handyman, physical exercise, party game, and general knowledge discs are beginning to enjoy considerable success.

Levels of interactive videodisc systems

Most commonly, interactive videodisc systems are classified according to their degree of complexity. This method has been reported by Kemph (1981:648), Onosko (1982:91), Daynes (1982b:49-53), and Parcloe (1983:84) and comprises three levels of interaction:

Level one: This level comprises stand-alone consumer players such as the Pioneer VP-1000, which offer remote control, rapid random access, variable quick and slow motion both backwards and forwards, and freeze-frame. However, no branching or other variable programming facilities are included.

Level two: These are educational industrial players which incorporate a small programmable microprocessor. Only two such systems are currently available in the US - the Discovision models 1,2, and 3, and the Sony LDP-1000. These players can be programmed on a limited basis to execute a set of frame searches and autostops, to wait for input from the user, and to branch back into the programmed instructions accordingly. Programs are recorded onto the second audio track of the disc and loaded into the player's RAM.

Level three: These systems consist of either level one or level two players interfaced to a microcomputer. Level three devices are powerful interactive instructional systems often involving complex hardware interconnections, and considerable courseware production effort. The balance of this paper is concerned with such systems.

Computer-videodisc interface

Computer-videodisc interface devices lie at the heart of level three videodisc systems. Depending on their complexity they enable interconnections between the computer, videodisc player, VDUs, and many other peripheral devices.

The problem with the current generation of videodisc players is that uniform industry technical standards have not yet been established. This means that only some players can be computer-interfaced. It also means there is presently no common interface device for all applications. Users either fabricate their own interfaces, or purchase purpose-built off-the-shelf boxes from a small number of US manufacturers.

For example, Aurora Systems Inc. have developed an interface box specifically designed to interconnect the Pioneer VP-1000 player with an Apple II computer. As detailed by Ahl (1982:56-57), this interface enables the computer to duplicate all the videodisc remote controller functions (play, stop, freeze, step-forward, step-reverse, shuttle search to address indicated, slow forward and backward motion), and as well as sending a control signal to the player can also accept the player video signal and marry it with the video signal from the computer. However the Aurora interface cannot display both video signals simultaneously, and instead merely switches back and forth between the two video signals. The interface is supplied with a DOS floppy disc which enables the incorporator of videodisc player commands into the Apple programs, and retails for $US250.

Another box is manufactured by Allen Communications Inc. which interfaces the Apple II to the Pioneer VP-1000, system also comes with a DOS floppy disc, and retails for $US575 (Onosko 1982:92).

In generously funded experiments conducted by the US Army (reported by Ferrier 1982:315) an IBM Personal device custom built by Interactive Training Systems Inc. This box (the ITS II) can handle multiple video inputs so that more than one disc player can be utilised, and accommodates such features as a touch sensitive screen and graphic overlay on video.

The US experience has been that videodisc players with a built-in RS-232C serial port are most easily computer interfaced, and this presently limits the range to the educational/industrial players produced by Discovision Associates and Sony. It should also be noted that interface devices manufactured in the US are all configured to the 525 line, 60 Hz field, NTSC colour TV standard and are thus not useable for PAL (the Australian standard) or SECAM configured equipment.

From a British point of view, Parsloe (1983:85) has observed that this incompatibility is a real problem. He says that the decision facing many potential users of interactive computer-videodisc systems is between adapting the master videotape to suit locally available disc hardware, or employing universally a system which may not be compatible with local standards. The series of videodisc programs produced by AAV-Australia Pty Ltd. for GMH (Ogden 1983:20) was developed to NTSC standards and necessitates the use of NTSC players and monitors by GMH dealers in Australia.

In the future when hardware convergence has been developed to a more sophisticated level we can probably expect instructional videodiscs to be encoded with all courseware requirements for an instructional sequence, including computer programs, alphanumeric information, and video sequences. At present these functions are spilt between memory devices in the computer, and the videodisc.

A complex computer-video interface

Backer (1982:26-27) has described a complex computer-videodisc presentation system developed by the Architecture Machine Group, Massachusetts Institute of Technology, which serves as an exemplar of this new instructional medium.

The system has three components:

1. **Hardware** that supplies the imagery and the means for impute, comprising a microcomputer, two interfaced videodisc machines, a colour graphics processor, a video effects generator, stereo audio amplification, and a single colour VDU with touch sensitive screen, all interlinked into an integrated system.
2. **Software** for the videodisc players and computer that generates the graphics for the viewer functions, handles interactions, controls the imagery.
3. **The imagery and sound**, and the database that represents it.

This arrangement can be considered a sub-system of an elaborate and sophisticated supra-system comprising courseware design, production, and evaluation processes and learning experiences and outcomes. I will later describe some of these aspects in more detail.

In operation, the videodisc players generate video images which are mixed by the video effects unit with computer-generated graphics which also represent the interactive controls. A touch-sensitive screen mounted on the VDU senses input to the screen, and provides the means by which a user selects program content.

This screen allows the viewer to interact. The system is interruptable and always responsive to the viewer so that sequence changes can occur at any point rather than at specific "branching" points. Thus, programs are continuously interactive, and are driven by "simultaneous processing" from the system, as it dynamically selects the visual and sound material based on the viewer's input, and by the viewer, whose interests and wishes may change as the program progresses.

The use in this system of a touch-sensitive screen as the exclusive means of learner input is an interesting departure. Most Computer-videodisc systems use the computer keyboard for input (as is the case with CAI programming). Other input techniques reported include light pens, paddles, joysticks, voice control (Withrow 1983:26), and sensors implanted in models connected to the system (Hon 1982:118).

Integration of courseware design and production

The convergence of computing with videodisc and other peripheral hardware for presentation of interactive instructional programming also involves the integration of many related courseware design and production concepts and functions.

In the Nebraska Videodisc Design/Production Group at the University of Nebraska (Dayness 1982a:24) an integrated team approach is used for each design/production project involving an instructional designer, at least one content specialist, a scriptwriter, an engineer, a computer programmer, and a video producer/director.

To produce the American Heart Association computer-videodisc cardiopulmonary resuscitation simulator system (Hon 1982:112-120) a design/production team was assembled which comprised a television scriptwriter (who doubled as the production co-ordinator), two content specialists (both cardiac surgeons), two senior Sony videodisc engineers, two computer engineers, a video producer/director, a full video production crew, two systems designers, a computer programmer, two audio engineers, and 65 program evaluators.

A design/production flowchart for computer-videodisc courseware published by WICAT Systems Inc. (1982:56-57) details an activity sequence integrating needs analysis, instructional design, media selection, script writing, artwork, computer programming, formative and summative evaluation, talent selection and coaching production planning, photography, and video and audio engineering.

The clear evidence is that design/production activity in this sort of educational technology is significantly different to that involved with lower-level technologies. An unsophisticated tape- slide program can be designed and produced quite comfortably by a single teacher possessing minimal competence in photography, sound recording, and scrip/writing. By contrast, a computer-videodisc program requires input from a team of specialists, and this fact must be significant when we consider the future use of this technology in educational settings particularly in Australia.

Courseware design

Carefully designed courseware is another key to the successful integration of videodisc and computer. The power of the technology is immense, but can only be exploited with a highly imaginative and creative approach to instructional design, computer programming, and video production. This approach is a significant departure from the lineal thinking engendered by earlier mediums. Computer-videodisc systems can offer a multiplicity of audiovisual parameters in presentational sequences randomly chosen according to learner responses.

These parameters include: coloured multimotion pictures. colour still pictures; coloured still and moving graphics which can be manipulated by the user; displays of alphanumeric information which can be overlayed onto picture or graphics backgrounds or displayed in split screen; dual audio tracks which can be utilised together or separately with both motion or still pictures. a variety of user input methods; and complete random accessibility to the database. It is clear that in order to avoid using the medium simply as a repository of visual segments, properly designed courseware is essential.

Instructional design

Nugent (1980:29), Glenn (1981:61), Blizek (1982:106), Dayness (1982a:24-25), Kehrberg (1982:98-100) and Copeland (1983b:74-76) have all provided numerous examples of computer-videodisc instructional design considerations. Some of these are summarised as follows:

1. A preliminary factor is consideration of the particular computer-videodisc system the program will be designed for. Because options presently vary from system to system the designer cannot ignore the impositions of hardware configuration.
2. It is necessary to choose the most appropriate symbol or code (pictures, print, and/or audio) for each unit of instruction, and to decide if picture motion is required (and if so, what sort). With videodisc the designer has an unprecedented opportunity to match the information to be presented with the optimal code.
3. A decision should be made as to whether and when interaction is appropriate, as this will influence the linearity or nonlinearity of programming.
4. The appropriate locus of control should be selected. This can lie either with the computer, the learner, or a combination of both. If control rests solely with the computer, the learner may be given little opportunity to select individualised strategies most appropriate to personal learning styles.
5. Programming needs to be stimulating and "human", rather than appearing to come from a cold, sophisticated information system. One aspect of this is that sequences need to have a high repeatability value.
6. The Nebraska group (Daynes 1982a 24-25) has defined seven sets of videodisc frames: orientation information, content, decision, comment, summary, problem, and "help". Each category of information has a specific function in an instructional sequence

There are many more examples available. The important point emerging from the literature is that instructional designers using this medium need to be aware of its unique possibilities, the technical limitations of systems, and the various options open to computer programmers and video producers working on the design/production team.

Computer programming

Bejar (1982:88-100), Daynes (1982b: 58-59), Lubar (1982:62-70), and Hon (1982:120-132) have all reported various underlying programming considerations.

With regard to the creation of visual displays, Bejar stresses the need for control structures in programming which support "electronic visualisation". Citing DeFanti (1980:90) he argues that existing computer languages do not contain control structures capable of creating and manipulating electronic images in real time. Likewise the software support for videodiscs in education often lacks the capability for overlaying video and for permitting responses on the part of the student other than choosing from a given set of alternatives.

Bejar also notes the recurring problem of program portability. He says that because, inevitably, different schools will have different software development costs are growing, developers should create software that can be run on a number of different systems, thus making it fully transportable.

With regard to learner interaction, Hon has shown that a difficult programming task can be the creation of algorithms which accurately assess the value of multiple learner responses. In order to assess learner performance takes too little or too much time, and whether each part of the performance occurs in the proper sequence. Based on this evaluation, the software then displays the appropriate graphics and video demonstrations and explanations of how to improve performance. This can lead to the creation of complex program control structures.

These are only three examples of the programming idiosyncrasies in computer-videodisc system. To a certain extent they can be managed by teachers using authoring systems such as Apple SuperPilot (Kellner 1982:104-105) which enable generation of high resolution colour text and graphics, as well as incorporating a set of videodisc control commands. However, complete mastery of videodisc-computer systems requires sophisticated programming skills. There are clear implications in that for educators if the technology is to succeed in educational settings.

Video production

Blizek (1982:108-110), Dayness (1982a:25-26), and Wright (1982:18,112) have described in great detail the sorts of video production possibilities, strategies, and problems presented by computer-videodisc systems. Some of these are:

1. The pace of video programming can be varied according to content demands and as a means of stimulating user attention. Certain kinds of information such as rule statements, examples, and problem solving sequences can be added as a series of still frames and segments can be repeated. This serves to slow pacing whereas motion sequences played at normal speed or faster can achieve different responses.

2. Programs can be organised like a book, with a table of contents and a series of chapter like segments. Others may follow the conventional pattern of beginning, middle, and end. Some may be organised into a series of discrete tracks with the actual sequence being determined by user responses.
3. The style of video programming can be very direct and personal. The narrative or dialogue can communicate directly to the user, and elicit direct responses. An open ended approach can allow the user to provide conclusions or choose amongst alternatives.
4. Content can be broken down into a series of short segments with no transitions linking them, or with transactions that allow segments to be used in various combinations. Some video segments containing references or optional materials may never be seen by anyone.

As with other elements in computer-videodisc production, video producers need to be cognisant of the technical limitations of likely player systems, and of the new problems and possibilities presented by computer-controlled access to video segments. This means they need to work closely with instructional designers and computer programmers, and need to be in possession themselves of some of those skills.

Costs of computer-videodisc educational technology

Because of the newness of the technology and the volatility of the market it is too early for an accurate or comprehensive determination of cost to be made. So far, commentators in the US have been very wary of making firm predictions. In the Australian setting it is impossible even to envisage vaguely what likely costs will be.

However, certain generalisations can be made. Although dependent on a number of factors, educational users of the medium can expect that outlays on presentation hardware and finished discs will pale into insignificance when compared with program development costs. When we consider the financial implications of the sorts of production efforts I have so far outlined it is clear that major cost-benefit issues arise. These will only be satisfactorily resolved when economies of scale are introduced. That is turn means each instructional program will need to be distributed very widely to reduced unit costs.

At present in the US, the hardware components of typical computer-videodisc presentation systems can be assembled for between $US3000 and $US5000. Those costs are bound to reduce in line with all other information technologies. We can safely predict that the day will come when the price of such systems will be of the same order as today's lower-level educational technologies.

Individual discs are being pressed in US, Japanese, and European plants for between $US10.00 and $US20.00 a copy depending on production run quantities (Fisher 1982:111-112), plus setting up costs of around $US2,000 per run. Butler (1981:17) has calculated that on these figures videodisc duplicating costs outstrip videocassettes unless large production runs are ordered. This high duplication cost is caused by the present nonerasability of videodiscs by users. Perhaps when the erasable disc penetrates the market single-unit duplication costs will decrease.

However, the costs of program production can be enormous. Butler quotes between $US500,000 and $US700,000 for sufficient videodisc courseware for a one-year college course. He says videodisc producers report one-hour consumer discs cost $US100,000 to develop, with breakeven point reached when 2,000 discs are sold. It is clear that if educators wish to utilise the technology they will need to be in a position to share developmental costs, and Butler suggests the formation of educational consortiums to achieve this.

It should be pointed out that disparity between hardware and courseware costs is no different to any other form of instructional media. For example, the costs of producing an effective slide-tape sequence are considerably higher than the cost of one presentation unit. However it is true to say that new financing arrangements implicit in the introduction of computer-videodisc technology will not begin to pervade US schools until the middle to late 1980s. That probably means we can expect its appearance in Australian schools Sometime during the 1990s.

Educational research

So far very little computer-videodisc research has been reported. In the literature survey which preceded compilation of this paper only two research reports were located.

One (Andriessen and others 1980) comprised a simple experiment conducted at the Philips Research Laboratories to observe learner reactions in a computer-videodisc instruction environment. It was largely designed to provide data for improving system hardware layout and courseware sequencing. Apart from developing a quantity of technical material the study also collected impressionistic data from participants. In general, subjects expressed positive opinions about their experiences with the medium.

The second (Boen 1983) was a comparative study in which two groups of subjects were taught an identical instructional sequence, one by computer-videodisc, and the other by traditional lecture method. The results were subjected to statistical tests of comparison and it was concluded that the group receiving instructional from computer- videodisc passed the final tests with a significantly higher score than the traditional group.

However, as Butler (1981:17) says, considerably more research is needed into the medium to establish the precise nature of its educational efficiency and effectiveness, and to determine administrative savings in learning time, classroom space, and staffing, as well as appropriate methods for the preparation of educational organisations for its inevitable wider use.

Conclusion

My concern in this paper has been with the convergence of video, audio, and computing technologies into videodisc based interactive instructional systems. My objective has been to examine some of the elements of these systems, particularly hardware configurations and courseware design and production procedures.

From readings of the steadily increasing quantity of literature about computer-videodisc systems beginning to flow from US and British sources I have identified four basic issues:

- The computing equipment, videodisc players, videodisc production facilities, and computer-videodisc interface devices have been developed and in some instances are now in the process of refinement. At present, this hardware is only freely available in the US, Japan, and Europe. There are a number of portability/compatibility hardware issues which need to be resolved.
- Some institutions and corporations are actively engaged in educational courseware experimentation and development. In the US these include the University of Nebraska, University of Utah, University of Minnesota, University of Florida, and the Massachusetts Institute of Technology. The United States armed forces are conducting generously funded trials of the technology as tools for military training. Predictions about future use tend to be optimistic.
- The technology comes in the form of integrated systems which involve interrelationships, interactions, and interdependencies between new machine and new human processes. These systems are significantly different to traditional education systems.
- There are many unresolved aspects of the technology, including costs, reliability, and educational efficiency and effectiveness. These issues may be settled with the passage of time, and in the course of further research.

It remains to be seen how computer-videodisc educational technology will be received by educators trained in traditional educational methodologies. It cannot be considered an "audiovisual aid" which will be easily absorbed into traditional classrooms. Rather, it is better seen as an alternative to traditional methods, and therein probably lies the seeds of a major educational controversy.

Annotated bibliography

Ahl, D.H. (1982). "Aurora Systems Videodisc Controller", *Creative Computing*, 8, 1, 56-57.
Describes a low cost ($US250) videodisc interface manufactured by Aurora Systems Inc. which links the Pioneer VP-1000 Videodisc Player to an Apple II microcomputer.

Andriessen J.J. and Kroon, D.J. (1980). "Individualised Learning by Videodisc", *Educational Technology XX*, 3, 21-25.
Describes an experiment conducted at Philips Research Laboratories, Geldorp, The Netherlands, using a Philips VLP videodisc player driven by a Philips P857 minicomputer. A short instructional course was prepared and presented using the system and learner opinions and reactions were collected.

Backer, D. (1982). One-of-a-Kind Video Programs. *Instructional Innovator* 23, 2, 26-28.
Describes experimental interactive video/computer instructional systems built by the Architecture Machine Group at Massachusetts Institute of Technology. System Comprises a microcomputer interlinked to two videodisc players, a colour graphics processor, video effects generator, and a monitor with touch sensitive screen. Outlines operation of system, instructional design technique used, and disc production method.

Bejar, I.I. (1982). "Videodiscs in Education: Integrating the Computer and Communication Technologies". *Byte*, 7, 6, 78-104.
Very detailed article discussing educational implications of interactive videodisc technology based on recent trails performed at the Educational Testing Service, Princeton, NJ. Reviews hardware considerations and options (videodisc players and microcomputers); technical and software interface problems; software issues; programming style; courseware peculiarities.

Blizek, J. (1982). "The First National Kidisc - TV Becomes a Plaything". *Creative Computing*, 8, 1, 106-110.
Outlines program design and production techniques utilised in development of US children's entertainment/instructional videodisc interactively controlled by microprocessor built into the Laservision videodisc player. Emphasises innovation methods necessary to utilise full capacity of system.

Boen, L.L. (1983). "Educational Technology Research: Teaching with an Interactive Video-Computer System". *Educational Technology XXIII*, 3, 42-43.
Brief description of a study which compared Computer Directed Instruction (CDI) utilising a video-computer system with traditional lecture method. Results were subjected to a statistical test of comparison which showed students instructed by CDI scored Significantly higher than those taught by traditional method.

Butler, D. (1981). "5 Caveats for videodiscs in Training". *Instructional Innovator*, 26, 2, 16-18.
Appraisal of videodisc instructional systems which highlights their technical limitations, difficulties of mass producing quality instructional software, costs of software development, and certain other obstacles. Concludes that potential of medium far outweighs obstacles.

Clement, F. (1981). "Oh Dad, Poor Dad, Mom's Bought the Wrong Videodisc and I'm Feelin' So Sad". *Instructional Innovator*, 26, 2, 12-15.
General description of videodisc characteristics and potential. Emphasises differences between various systems, especially between lineal and random-access units, and compares four player systems - reflective optical, transmissive optical, grooved capacitance, and grooveless capacitance.

Copeland, P. (1983a). "An Interactive video System for Educational and Training". *British Journal of Educational Technology*, 14, 1, 59-65.
Description of the development and testing of a British video/computer interactive instructional system called CAVIS. System utilises a microcomputer-driven VHS videocassette recorder/ player. utilises computer generated alphanumerics and VHS video segments in various random combinations.

Copeland,P. (1983b). "CAVIS - From Concept to System". *Media in Education and Development*, 16, 4, 74-79.
More comprehensive and recent version of previous article by the same author. Includes reference to use of videodisc in an interactive video system, and more detailed treatment of courseware production methodology.

Daynes, R. (1982a). "Experimenting with Videodisc". *Instructional Innovator* 27, 2, 24-44.
Outlines techniques used at Nebraska Videodisc Design/Production Group, University of Nebraska, to produce instructional videodisc/computer programs. Describes production sequence from design to premastering tape stage, and highlights differences of pace, organisation, and style inherent in CDI/videodisc programs.

Daynes, R. (1982b). "The Videodisc Interfacing Primer". *Byte*, 7, 6, 48-59.
Comprehensive and well illustrated description of videodisc systems, CDI/videodisc programming techniques, and production methods utilised at Nebraska Videodisc Design/Production Group. Includes a glossary of videodisc interfacing terminology.

DeChenne, J.A. and Evans R. (1982). "Simulating Medical Emergencies". *Instructional Innovator*, 27, 1, 23.
Describes a CDI/videodisc system used to simulate medical emergencies and used in the training of medical emergency specialists. Software is an involved branching program interlinked to videodisc. Includes full sound effects of injured patients.

DeFanti, T. (1980). "Language Control Structures for Easy Electronic Visualisation". *Byte*, 5, 11, 90. Cited by Bejar, I. (see above)

Ferrier, S.W. (1982). "Computer-Aided Interactive Video Instruction: Closing the Gap Between Needs and Outcomes in Competency-Based Leadership, Management, and Organisational Development Training". *Programmed Learning and Educational Technology* 19, 4, 311-316.
Detailed account of a CDI/videodisc project implemented at the US Army Organisational Effectiveness Centre and School, Fort Ord, California. Outlines nature of OE skills required of Army officers and difficulties of achieving instructional results using traditional lecture methods (needs analysis). Describes CDI/ videodisc system developed by Interactive Training Systems, and results of implementation of that system. Concludes that method is a valid, efficient, and cost-effective adjunct method of training suitable leadership, management, and OE behaviours.

Fisher, D. (ed.) (1982) "Videodisc Status Report". *Screen Digest*, June.
Comprehensive analysis of videodisc technology and state of the international videodisc developments and market. Lists world hardware manufacturing facilities (including statistics on output) and manufacturers of programming and courseware. Includes details of pressing costs, and a review of overall prospects. Concludes that videodisc will be a potent force for change in information industry.

Fist, S. (1980). Videodisc: Coming Ready or Not. *Australian Video Review*, 1, 1, 28-30.
General outline of videodisc technology, system types and potential applications. Includes very detailed descriptions of electronics involved.

Fist, S. (1981). "The Logical Case for Videodisc". *Australian Video Review*, 1, 5, 18-19.
Overviews development of videodisc. Compares videodisc with videocassette. Speculates on future competition to videodisc from bubble memory systems and holography.

Glenn, A.D. and Kehrberg, K.T. (1981). "The Intelligent Videodisc: An Instructional Tool for the Classroom". *Educational Technology XXI*, 10, 60-63.
Description of the development, testing, and application of an interactive CDI/videodisc instructional system prepared by the Minnesota Educational Computing Consortium, St. Paul, Minnesota. System utilises an Apple II interfaced with a Pioneer VP-1000 videodisc player, and software for a five-unit course in economics. Outlines education! advantages of the interface, and identifies certain key issues for users and developers of similar systems including organisation for courseware development, costs, hardware selection, and training of educators.

Harris, J. (ed.) (1982). "Bell and Howell Self Writing Training Software". *Australian Video Review*, 2, 5, 22.
Brief description of the Bell and Howell Professional Authoring Software System (PASS) run on a 48K Apple II driving either a VHS or Beta videocassette recorder/player or the Pioneer Discovision Videodisc player.

Hon, D. (1982). "Interactive Training in cardiopulmonary Resuscitation". *Byte*, 7, 6, 108-138.
Extremely thorough description of the development, testing, and implementation of an interactive instructional program for training medical emergency workers in correct technique of CPR. system is based on CDI/videodisc hardware linked to electronic manikins. Courseware provides instruction, prompts, questions, performance monitoring and assessment.

Hooper, R. (1982). "Keynote Address to the May 1982 ASET Conference on The Use of Telecommunications in Education and Training." Australian Society of Educational Technology, Sydney, (audiocassette).

Jarrett, G. (1983). "Philips Ties its Interactive Future to Teletext". *Audiovisual*, 133, 45.
Report of an interview with Paul Bradley of Philips Industries regarding future developments by Philips of interactive CDI/video technologies. Claimed that despite advantages of videodisc, non- erasable recorded technologies must be replaced with systems which allow rapid information update and alteration. Cites teletext technologies as a possible option.

Kehrberg, K.T. and Pollack R.A. (1982). "Videodiscs in the Classroom: An Interactive Economics Course". *Creative Computing*, 8, 1, 98-102.
Description of the Minnesota Educational Computing CDI/video interactive economics course including student interactions, the development process, production and post-production, costs, and future potential.

Kellner, C. (1982). "V is for videodisc". *Creative Computing*, 8, 1, 104-105.
General description of the Apple II/Pioneer VP-1000 interactive system written by an Apple Computer Inc. courseware developer. Includes brief description of some programming features using Apple SuperPilot, an instructional authoring language.

Kemph, J. (1981). "Videodisc Comes to School". *Educational Leadership*, 38, 8, 647-649.
General overview of entire educational CDI/videodisc field written by a producer-director at Nebraska ETV. Describes system capabilities and levels of interaction. Outlines two pilot programs: "Basic Tumbling Skills" and "Mejore Su Pronuncacion" produced by Nebraska Videodisc Design/Production Group. Says that medium is hampered by shortage of good quality software.

Kozen, N. (1983). "videodisc Bibliography". *Educational Technology XXIII*, 2, 52-53.
Bibliography of US CDI/videodisc literature including 25 journal articles and two books.

Lubar, D. (1982). "Adventures in videoland". *Creative Computing*, 8, 1, 60-70.
Very detailed description of design and programming method for production of a microcomputer/videodisc interactive game called "Rollercoaster", including a full program listing (BASIC).

Marsh, P.O. (1983). "Ed Tech Professional Literature Reviews: Videodisc/ Microcomputer Courseware Design". *Educational Technology XXIII*, 3, 51-52.
Detailed review of DeBloois M.L. (ed.), *Videodisc/Microcomputer Courseware Design*, Educational Technology Publications, New Jersey. Describes content of book, and general system characteristics of interactive videodisc. Identifies 6 major issues related to implementation of CDI/videodisc.

NUGENT G.C. and Stone C.G. (1980). "Videodisc Instructional Design". *Educational Technology XX*, 5, 29-32.
Article written by a designer and a scriptwriter with Media Development Project for the Hearing Impaired, University of Nebraska States that CDI/videodisc courseware design follows same sequence as any media product but that certain new procedural elements are introduced: consideration of the CDI/videodisc system to be used; selection of best combination of symbols and codes; selection of interactivity; selection of control locus - learner or computer? Describes a selection of authoring strategies.

O'Brien, R. (1983). Erasable Discs May Oust VTRs. *The Australian*, Monday 30 May.
News item from Tokyo correspondent reporting the development by Matsushita of the erasable videodisc. Instead of using pitted disc, erasable discs have a coating of germanium and indium on tellurium oxide. Laser shots change this compound from crystalline to non- crystalline and vice-versa. Article also mentions similar development by Sharp.

Ogden, J. (ed.) (1983). "Interactive video". *Arts and Education*, May, 20.
Question-and-answer promotional article describing interactive videodisc programs prepared by AAV-Australia.

Onosko, T. (1982) "Vision of the Future". *Creative Computing* 8, 1, 84-94.
Comprehensive overview of videodisc to microcomputer interface technology which describes, compares and classifies systems; discusses characteristics; and details certain entertainment and instructional applications. Concludes with a number of predictions, including mention of bubble memories.

Parsloe, E. (1983). Interactive Video. *Media in Education and Development*, 17,6, 83-86.
Overview of entire interactive video/microcomputer field by UK writer. Details hardware and software problems and prospects. Concludes that technology presages a major revolution in education and training.

Thomas, W. (1981). "Interactive Video". *Instructional Innovator*, 26, 1, 19-44.
General review of interactive video including teletext, videodisc, and computer interfaced videodisc and discusses prospects.

Thorne, K.G. (1979), "The Teledec Video Disc". *Audio Visual Australia* 2, 1, 6-8.
Early review of principles of videodisc technology. Includes statistics data showing decreasing software and hardware costs of Videodisc and videocassette compared with project media. Describes a capacitance videodisc system called the Teledec video disc (now outmoded).

Toffler, A. (1980). *The Third Wave*. New York: Morrow.

Walker, J. (ed.) (1981). "What's New in Video?". *Instructional Innovator*, 26, 2, 8-11.
Describes a number of new developments in video hardware, including interactive computer driven videodisc and videocassette systems. Details some obstacles to these innovations, and mentions cost/benefit considerations. Concludes that new technologies will benefit education.

White, B. (1982). How to prepare for videodisc. *Instructional Innovator*, 27, 11, 17-18.
Brief introduction to instructional videodisc which emphasises importance of learning correct techniques for evaluating videodisc courseware. Notes that videodisc is a potent instructional medium which could be easily abused or misused, thus lessening instructor credibility.

WICAT Systems Inc. (1982). "Interactive Videodisc Design and Production. *Byte*, 7(6), 56-57.
Illustrated flowchart detailing design and production schedule for interactive videodisc/microcomputer courseware development.

Williams, D.V. and Gayeski, D.M. (1983). "Interactive Assessment". *Instructional Innovator* 28, 2, 21-22.
Discusses usefulness of interactive computer/video systems for providing immediate assessment feedback on learner performance, as well as a range of other activities, preferences, and attitudes. Says that technology based interactive assessments provide greater learner motivation, increased "face validity', shorter testing time, better test scheduling, improved test security, and improved timing and pacing.

Williams, N. (ed.) (1983). "New Laser Disc Can Record and Play Back". *Electronics Australia*, 45(7), 6.
Description of the Matsushita germanium/indium/tellurium oxide erasable videodisc. Includes diagram.

Withrow, F.B. and Roberts, L.G. (1983). "Video with Razzle Dazzle". *Instructional Innovator*, 23, 3, 24-26.
Detailed overview of convergence of TV, video, microcomputing, and telecommunications. of particular interest is description of developments in interactive TV and video, and random access video using voice activated interaction. Ends with optimistic description of future of educational technologies.

Wright, V.O. (1982). "How to Format Slides for videodisc". *Instructional Innovator*, 27, 11, 18-112.
"How to" article which describes procedure for preparing photographic slides for videodisc mastering. Includes specifications for aspect ratio, safe image area, slide exposure, multiple stills, and simulated motion.

Please cite as: Dunbar, R. (1985). Computer videodisc education systems. *Australian Journal of Educational Technology*, 1(1), 21-38. http://www.ascilite.org.au/ajet/ajet1/dunbar.html