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ABSTRACT

This collection contains 30 selected papers and abstracts of six additional papers from the 1990 Conference of the Australian Society for Educational Technology. Titles and authors of the papers are as follows: (1) "Interactive Media into the Millenium" (Clark); (2) "Open Learning Centre Network Project and the Preparatory and Remedial Education Project for Higher Education in Queensland" (Gooley et al.); (3) "Teaching with Telematics" (Conboy); (4) "Computer Based Training and the RAN" (Triantos); (5) "Computerised Out-of-Class Exercises" (Phelan); (6) "The Impact of High Touch in the High Tech World of Education" (Bollet, Cornell); (7) "The Use of the Satellite and Teleconferencing in Real Estate Distance Education" (Harrison, Trowbridge); (8) "Divergence" (Forsyth); (9) "D-I-Y Publishing for the Production of Distance Education Courseware" (Kemp); (10) "Keyboarding, Touch Typing and Computers" (McKinnon, Nolan); (11) Starting Think-Keying" (Carnegie); (12) "Developing a HyperCard Training Package" (Sparks, Hall); (13) "HyperCard Workshop" (Dickenson); (14) "SIULLEQ--A Multimedia Database about Greenland" (Looms); (15) "The Cooperative Development Process of the Agency for Instructional Technology" (Nelson); (16) "Rural & Remote Learning Centres" (Kirk); (17) "Electronic Mail" (Russell); (18) "Developmental User Groups for Ongoing Computer Training" (Hughes); (19) "Microcomputer Implementation in the Primary School" (Kershaw, Cousins); (20) "The Convergence of Teaching and Production in Media Centers" (Ramsay); (21) "Developing Guided Self-Study Materials for Higher Education" (Fox); (22) "'Chronic Blood Transfusion': A Video and Resource Book..." (Lewis, Green); (23) "Interactive Videotape and Videodisc Language Packages" (Lobb, Cartwright); (24) "The Use of Interactive Video Conferencing in Education and Training" (Jamieson, Rees); (25) "Developing Instructional Videos in Indonesia" (Jolliffe); (26) "Educational Technology in Malaysia" (Hedberg); (27) "Developing an Intelligent Tutoring System" (Hall); (28) "Expert Systems and Education" (Gedgovd); (29) "A Computer-Based System for Developing Expertise in the Diagnosis and Remediation of Common Error Patterns in the Domain of Fractions" (Mason, Martin); and (30) "Using CD-ROM and Multi-Media for Education and Training" (Shaw, Standfield). An author index is provided. (DB)

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Converging Technologies — Contents

Preface

John Dawkins
Minister for Employment, Education and Training

In 1988 it was my pleasure to attend the last national conference of the Australian Society for Educational Technology, and I am delighted to renew our acquaintance in this way for the 1990 conference.

Development of the arts and sciences of educational technology forms an important part of our national educational endeavour. Innovations in educational media, computer-based instruction, educational television, and educational telecommunications, especially those which explore their convergence, are essential if we wish to create a truly modern, effective, and cost-efficient means of delivering high quality instruction.

I commend the work of the Australian Society for Educational Technology in fostering these innovations through activities such as the national conference and the ASET Awards Scheme, and wish the Society and its sponsors every success for your 1990 gathering in Sydney.

Interactive Multimedia into the millenium: it's time to simplify

David R Clark Ph.D
Director, University of London Audio-Visual Centre

This is a most exciting time for Interactive Multimedia. There is just a chance that soon we will discover what the word means. After some 10 years in the field, I am at last beginning to understand the realities behind the rhetoric that I and others have been peddling.

As a Keynote Speaker it is my responsibility to try and set you you off in the right direction. The trouble is that what I have to say may not be exactly what you want to hear. For almost the whole of its short and eventful life, our industry has been driven by technology: the needs of any prospective users have scarcely been considered, so sure have we been that with the gizmos to hand all their wishes and more could be fulfilled. We saw no real need to stop and ask.

To add to the distortion that this attitude has imposed on the marketplace, the driving technologies have been continually changing. Worse still, these changes have themselves had no necessity from the point of view of the tasks in hand.

It is a good idea to step back and review the systems that we have at our disposal in order to assess their suitability for the tasks that now seen to be paramount. In the assessment that I shall give, I pay particular attention to the origins of the technologies and their relationship to the wider world of communications. In all this there is a key concept: fitness for purpose. There is no doubt that everybody will agree when asked that the tool for the job must be fit for its purpose. But the consequences of the ready acceptance of the proposition for the multimedia industry are striking. The first and most obvious is the removal of CD-ROM from consideration as a serious delivery system for interactive multimedia. It has always been clear from theoretical analysis that CD technology is, by virtue of its low data rate, unsuitable for the delivery of images. As is usual, however, practical demonstrations are required before most people will believe theoretical conclusions. (This is perhaps a definition of education — the more educated you are, the less you need the practical demonstration of a theoretical idea to believe and understand it.) One only has to see the painful lurchings and grindings as images are dragged from the CD-ROM in response to the slick click of a mouse to realise that the constraints on the rhythm and flow of the user's thoughts that the drive imposes render the system useless in all but the most constrained and artificial systems. And that's just for still images. With moving pictures things are hopeless, and no amount of clever coding will get over the fundamental limitations imposed by the intrinsic data rate of the standard CD.

Of course, the reason for the CD-ROM hype is not far to find. The unprecedented consumer acceptance of CD-DA has brought the price of a drive down to $45 and the pressing plants have some spare capacity for short run productions. As the requirements of CD-ROM are electronically simpler than CD-DA (only error correction, not additional error concealment, is required) a high margin computer peripheral is just money for old rope. Thing to remember is that CD technology was highly optimised for just one purpose — fooling the ear. The exacting requirements of human hearing set the sampling depth and rate and the level of error fidelity. The promulgation of this as a universal standard is excellent for audiophiles but, just as your electric toaster is no use as a washing machine, CD's precise fitness for its purpose has rendered it unfit for the task of fooling another of our senses — our eyes. Many thousands of man-years have already been devoted to that task and the result is video.

Analogue video, in its old as well as its new incarnations as HDTV, is a beautifully optimised system for a particular task. One of the tragedies of the past decades has been the complete failure of those deeply involved in digital computation properly to appreciate the significance of the analogue video system. If it ain't broke, don't fix it, as they say in America, would have been a good maxim for all those who spent so much time trying to make pictures out of digits. There are undoubtedly some occasions when having an image in digital form is useful, but for the overwhelming majority of visual tasks this is not the case. The marriage of computers, an essentially minority interest, with the premier communications medium on the planet has been very unhappy. The tail has tried to wag the dog.

Another aspect of the problems confronting the multimedia industry is the failure by the practitioners to separate the concept of programme design from that of programme delivery. It must be very galling to Sony and Philips to feel that in order to sell one of their products, they must also see sold a computer that costs almost twice as much as their product. Both these companies have tried to ameliorate the problem by making computers of their own, with no success. The real truth is that a general-purpose PC is no good for *delivering* interactive multimedia. The Macintosh, the Amiga and the Archimedes have potential as engines for *creating* interactive programmes, where simultaneously there must be editors for programs and pictures, the control of peripherals such as videodisc players and overlay boards and the necessary modelling tools to construct and test the interactive programmes. The final result of these labours needs none of these things and can be delivered with its own fit-for-purpose delivery engine. The specification of this delivery engine has been my prime concern for the last 3 years.

As is always the case, the 'broad picture' is nothing but the sum of its fine details. If the details are not to hand the solution to the problem will be impossible The solution will always be particular; there is no such thing as a generic solution. In your kitchen you are unlikely to have the generic cooking tool, and those expensive devices that claim to do lots of wonderful things to your food at the press of a switch are often to be found on the top shelf gathering dust. Similarly, when you call for the plumber he doesn't have in his bag a universal plumbing tool; he has a very strange collection of things, each of which is precisely fit for a particular plumbing purpose. We must not forget this lesson when we try to understand the needs of those who suspect the our interactive multimedia tools may be of some use to them in the solution of their problems. Not only must the hardware be fit for purpose, but the programme too must reflect precisely those features that the customer requires. One of the factors in the overwhelming consumer resistance to acceptance of the new technologies is that they heretofore have required an unacceptable high degree of compliance by the customer to the artificial restrictions imposed by the technology.

Looking back over the last decade is not unlike looking again at those wonderful old pictures of early flying machines with their tiers of wings and improbable engines. When I see the piles of gear on the stages, the pairs of video projectors, the LaserDisc and CD players and MIPS by the gross and the almost inevitable collapse of the demo, often after a promising start, I realise that we are in the very early phase of the media revolution. I'm (almost) done with these extravaganzas because I have discovered that all the essential attributes of full interactivity can be delivered with no computer at all. As always, the simple solutions are the best.

Open learning centre network project and the preparatory and remedial education project for higher education in Queensland

Anne Gooley
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Steve Towers and John Dekkers
University College of Central Queensland

The provision of distance education using study centres or open learning centres as integral components of student support systems have considerable application, particularly in the highly decentralised regions of Australia. The use of study centres is not new in Australia. However, this paper details two of the projects funded by the Queensland State Government for the establishment of an open learning centre network for the delivery of distance education that is shared by all the higher education institutions and TAFE in Queensland. The paper also addresses the development of preparatory and remedial courses that have been funded specifically to take advantage of such a network.

Considered are the roles of technology and the roles of an open learning centre in fulfilling the needs of community members, students and institutions providing distance education courses.

For some years there has been concern about the accessibility of and participation in higher education, particularly by those people who live in remote areas of the State. This issue was addressed by the Government, *Committee of Inquiry into Higher Education Places in Queensland* (known as the Sherrin Committee, 1989). This committee subsequently allocated $4 million in the 1988/89 State budget to pilot a decentalised State-wide system for higher education delivery.

The main goals of this State-wide system are to increase access, equity and participation. Achieving these goals was seen to depend upon a number of factors:

- educational awareness/promotion
- availability of preparatory and bridging programs
- overcoming geographical and other forms of isolation
- flexible entry requirements
- course design
- available and emerging communication technology
- credit transfer capabilities
- quota management

It was decided that a State plan should be based on the needs of the student as the central starting point and that the expenditure of the grant should be aimed at taking some steps towards increasing accessibility. This can be best achieved through the cooperative development of properly designed distance education programs which can be delivered throughout the State, and beyond, using available communication technologies.

The State plan has been developed to ensure that people throughout the State would have access to all the resources of all education providers through on-campus and off-campus studies as far as practicable. The two basic elements of such a plan are:

- Cooperative establishment, maintenance and management of a network of open learning centres which effectively use a range of communication technologies for education, information and course delivery;
- Cooperative design, development and delivery of courses through the network of open learning centres and tertiary institutions.

Five major projects are being funded over a two year period. Namely:

- Development and implementation of the Queensland Open Learning Centre Network (OLCN) ($1.0 million)
- Development and delivery of courseware for preparatory studies and remedial courses (PREP) with special reference to science and mathematics ($0.5 million)
- Development and delivery of courseware for tourism, hotel management, and related studies ($1.0 million)
- Development and delivery of courseware for remote area Aboriginal and Torres Strait Islander Teacher Education Programme in North Queensland ($0.6 million)
- Development of "Project Pathways", a course information service ($150 000)

A number of smaller projects were also funded.

There is an acknowledgement that electronic technologies using audio, video and computer-based systems interaction can contribute to the quality of education for both on-campus and off-campus students. This use of technology can provide new forms of flexibility and extends human and other resources for the creative development and delivery of education.

The projects now in progress have taken a relatively cautious approach to the use of new and emerging technologies. The first steps towards a State-wide system are being based on sound experience, affordable systems and the pervasiveness of the carriers. By using the existing terrestrial telephone system for audio teleconferencing, electronic mail and facsimile and the postal service, it will be possible to reach almost everyone in the State. The projects have been mindful that they should not exclude people through decisions to use technology not widely available. However, some experimentation with emerging technologies is to take place for courseware being developed for use.

The challenge of the projects is for courseware designers to ensure that the advantages of the interactive power of these technologies are built into the programs and that their use is appropriate both in terms of the media and the educational objectives. These technologies have the power to facilitate interaction between students and lecturers in ways not previously possible and should improve the overall educational quality and access to programmes.

This document addresses the development and implementation of the Open Learning Centre Network Project and the Preparatory and Remedial Education Project.

Open Learning Centre Network Project

Background

Open learning has been adopted in a wide range of countries including Canada, Britain, Hong Kong, Thailand, India and Bangladesh. In Australia, Queensland leads the way with its Open Learning Project.

The use of communications technologies is an important aspect of an open learning model as it provides a range of learning opportunities to meet the needs of students wherever they live and an infrastructure for educational providers to share resources. For this to occur, there needs to be a basis for cooperation and coordination. The Open Learning Centres will provide this basis by enabling all the higher education institutions and TAFE to deliver programmes and other educational activities and information through a decentralised educational network.

By the end of 1990, there will be 35-40 Open Learning Centres throughout Queensland. Already 25 Centres have been established and Co-Ordinators appointed to manage them and act as local advocates for higher education and the TAFE sector.

The successful operation of the Centres depends on the management and dedication of the Co-Ordinator appointed, the equipment placed in the Centres, financial support based on a user-pays system and the local community giving its full support to Centres and the Open Learning Centre Project.

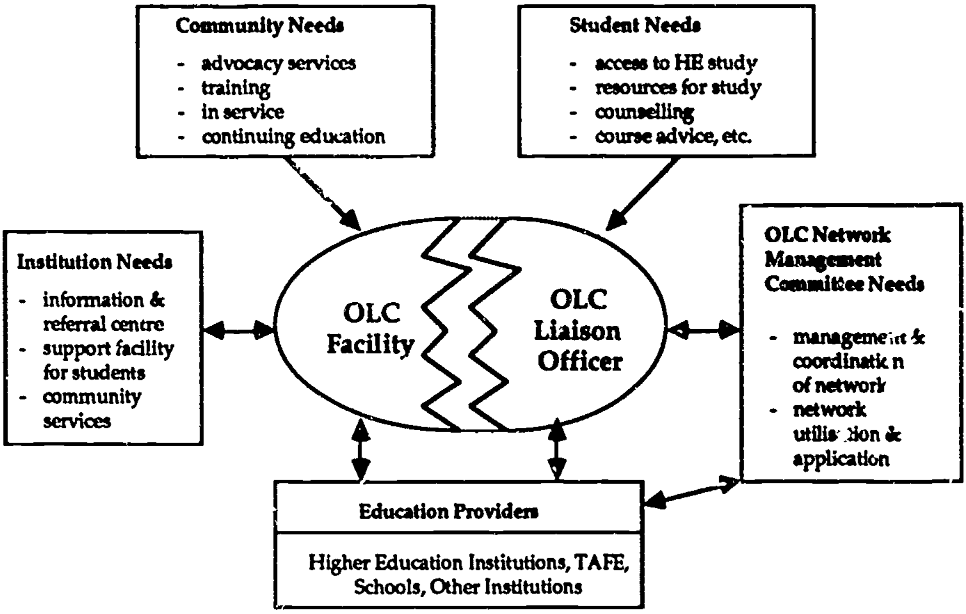
Aims of the Open Learning Network

The network has two main aims during 1989-1991:

- to provide links between the general community and institution in order to foster and promote participation in higher education
- to provide a support mechanism and service for persons in regional communities seeking to undertake education programs.

Needs and Roles of an Open Learning Centre

The role of the OLC facility and the Centre Co-Ordinator is shaped from the needs of four user groups: Community members, students, institutions and the management committee. The interaction between these groups and the OLC is shown in the following diagram.



In the above figure, community refers to commerce, industry, community groups, teachers, parents, secondary school students and private providers. Community needs for the OLC are as follows:

Centre Facility

- information and referral centre for education courses
- display and advertising of activities, etc.
- training and in-service facility
- teleconferencing centre
- consultancy service provided by higher education institutions

Centre Co-Ordinator

- career and course information and referral-advocate role
- information source for higher education and TAFE
- facilitator for training and continuing education courses
- facilitator and organiser of community events, e.g., career week activities, orientation and graduation function
- facilitator for consultancy services available from institutions
- linking of community needs to institutional facilities.

The Co-ordinators role is also to assist people in the community in setting up and using communication technology. For example, they will be able to train new users in how to access and use electronic mail facilities.

Students enrolled in tertiary institutions and TAFE Colleges are able to use a centre for activities such as:

- take part in lectures delivered by communication technologies

- meet with local students and visiting lecturers
- use Centre for quiet study
- fax assignments to their institutions
- gain 24 hour access to computers
- access study resources
- access on-line library catalogues
- obtain course and career information for all institutions in Australia
- sit for examinations.

Centre communications and computer equipment

The use of communication technologies and computers is a way of bridging the communication gap and improve information access to communities. In particular, the use of interactive electronic technologies such as audio, audiographic and computer based learning systems will considerably improve the quality of and access to education in isolated and remote communities.

Thus the following equipment will be placed in each OLC:

- computer hardware — printer and modem
- video player and monitor
- audio teleconferencing system
- fax machine
- telephone answering machine
- telephone lines for teleconferencing, E-Mail and Fax services.

Courses to be developed by PREP and other projects will contain a variety of delivery options including print-based materials, computer-based courseware, audio visual materials and other learning/teaching aids.

Use of Centres

Students undertaking distance education courses will be able to access institutional services directly from the Open Learning Centre and to contact lecturers and administrative and personnel sections. For those tasks, where a phone call during office hours is necessary, the Co-Ordinator will be able to follow through issues on behalf of students thus reducing the timelapse sometimes experienced as lecturers and students try to communicate.

"Project Pathways", an on-line course information service, will be available to all people in the community who are seeking information on all accredited higher education courses, including postgraduate courses and TAFE courses. It is envisaged that the Open Learning Centre will have an important role for course and career information for students and other members of the community. On-line links will ultimately be provided to CES offices and other government services to action information at an Open Learning Centre.

In order to maintain the currency of information and to include any improvements, it will be necessary to provide two updates of the information disks at centres per year.

Open Learning Centres have been established to serve the needs of communities. Community groups will be able to use these facilities for participation in multipoint communications. Thus, an Open Learning Centre may be used by different professional groups in a local area to communicate with another area or to participate in State-wide training programs or for the delivery of inservice programs and regional meetings of special interest groups.

Inservice and training programs for education and industry can also be delivered to Open Learning Centres via communication media for a fraction of the cost of face-to-face delivery. The cost advantages and ease of use should increase the support services and network strengths in remote areas.

At the present time a number of professional organisations (e.g. Australian Law Society) and community groups such as Rotary and Jaycees are expressing interest in using centres as communication bases. Also Government departments such as Education, Police and Primary Industries are seeing value in the concept and are potential users of the network.

Some Problem Areas

Finding a location for the OLC has caused a number of difficulties. The State Government grant is to establish the basic technology requirements that have been identified to drive the network and to pay for Co-Ordinators to manage the centres on a part-time basis. No funding was provided for a physical location, so the Project has had to rely on the generosity and cooperative spirit of TAFE Colleges, Higher Education Institutions, Education Centres, Schools and Local Community facilities to provide accommodation. Thus the network will be operating in a range of physical settings. Centre Co-Ordinators have a key role to play to ensure the proper functioning of each centre.

Co-Ordinators have to be well trained to do their work efficiently and to feel comfortable with the communication technology provided in the centres so they in turn can train the students and others in the community. Co-Ordinators must also be skilled in handling students who have difficulties with their courses and they need to have a very broad knowledge of course and career information so that they can help students and the community. In addition, the Co-Ordinators need regular or on-going support as they are very much working in isolation and to be able to feel that they can be in daily contact with the main officer of the Open Learning Centre Network in Brisbane if necessary. They must also be made to feel they are important staff members at each of the three Distance Education Centres. In the past, tertiary institutions, without realising it, tended to keep their 'Liaison Officer' as they were called, relatively uninformed. Lack of communication caused liaison officers many problems including a feeling that they were making little contribution to the operation of the Centres.

To ensure that all Co-ordinators are able to effectively fulfil their roles they are provided with an intensive training programme as a group. This training focuses on the development of skills needed to manage and operate the centre; becoming competent in the use of the technology available at each centre; and learning about the courses and other aspects of higher education and TAFE. The group training also is an opportunity for the Co-ordinators to better get to know each other.

Isolation, that can be experienced by all Co-Ordinators, is overcome by weekly reports on activities occurring throughout the whole network, monthly newsletters, a 008 number to ensure constant contact and feedback on problems, an answering machine in the main office in Brisbane, monthly teleconferences linking up all the Co-Ordinators in Queensland and the Management Committee. There will also be regular once a year training workshops for all Co-Ordinators.

Future Prospects

Initially, all OLCs and participating higher education institutions and TAFE will have the capacity to use electronic mail/computer conferencing, audio teleconferencing and facsimile. Subsequently, Queensland satellite television system (Q-NET-TSN11) will be incorporated so that the full range of media delivery options can be available. There is indication of industry involvement, therefore, private providers of training will become the major users of the network.

The use of technology in education should facilitate communication with students and between campuses and institutions. However, it must be acknowledged that it may never be possible to make available to all students the same type and level of communication and resources. For instance, students at remote homesteads and isolated farming and mining communities could have fewer opportunities for face-to-face contact with institutional staff and other students. Thus the range of communication options and access to resources for students in these locations will be more limited than is the case for students in cities and towns.

In the future, it is intended to broaden the scope of OLCs to include other sectors of education. It is envisaged that over the two year trial period, an overall State-wide system of management and organisation will be worked out. This will include the development and introduction of a user-pays system to ensure the longer term viability and extension of the network functions and capabilities. If a proper user-pays system can be developed and aspects of the OLC Network can be commercialised, the systems could become self funding. This is deemed possible, particularly if funding support is provided from commerce, industry and government authorities who use the Centre Network for the delivery and promotion of courses for training and upgrading course activity. At present there is a strong sense of cooperation, shared interest, and determination by institutions and community groups to ensure that the network will succeed in its endeavours.

Finally, it is likely there will be integration with overseas institutions, especially institutions in countries close to Australia. By communication with open learning universities in the Asian-Pacific countries, the Open Learning Centre Network could set up sharing arrangements for language education, middle-management courses and training in the use of communication technologies for open learning.

Preparatory and Remedial Education Project

The Preparatory and Remedial Education Project (PREP) concerns the development and implementation of a range of preparatory studies and remedial courses with particular emphasis on science and mathematics. Materials to be developed are to make creative use of alternate modes of delivery and, in particular, will be available for students through the Open Learning Centre Network (OLCN). The steps in the overall project include:

- community and institutional needs analysis for preparatory and remedial courses
- identification and evaluation of existing offerings at higher education institutions and TAFE.
- identification of appropriate modes of delivery; content/scope; technology used; and audience targeted for each of the courses
- building upon the present program to meet the needs identified in the first point
- developing inter-institutional infrastructure for offering of preparatory studies and remedial courses in mathematics, communications and science.
- implementing appropriate technologies such as the computer and telecommunications technology for the delivery and administration of the preparatory studies and bridging courses through the OLCN and other settings.

Based on the above the courseware design will:

- be flexible enough to meet the individual needs of the learners in the selection of modules and the requirements of the course they wish to enter
- use a variety of communication technologies for the efficient delivery and administration of the program
- make use of the OLCN for promotion and delivery of program
- be developed within a 'cooperative' model through the participation of all Queensland higher education institutions.

Technology

As previously mentioned, the Open Learning Centre Network will provide the delivery system for enhancing open learning. One of the main features of the courses developed by PREP that distinguishes them from previous preparatory and remedial courses is that they can take full advantage of the communication options offered by the OLCN. With this in mind the instructional design and management models developed for the project will ensure that course writing teams integrate a variety of these learning options into the courses.

Although the courses to be developed by PREP will be primarily print-based (as print is the most accessible medium for the majority of students), there are a number of learning-mode options to supplement and enrich the student's learning experience. Some of the learning options such as audio tapes, video tapes and teleconferencing will be available to the students at their homes whereas electronic mail, facsimile machines and Computer Aided Learning (CAL) will be available at the local Open Learning Centre.

Computer Aided Learning is seen as one of the innovative uses of technology for this project. Because of the nature of preparatory, bridging and remedial courses it was decided to use a software and hardware platform that offered maximum flexibility for the intended target audience. The authoring language 'Authorware Professional' running on a Macintosh CX was selected as the CAL standard for the project. This software and hardware combination offers the student a variety of stimuli for learning, for example, sophisticated video graphics, colour graphics, animation, quality typographical layout and digital stereo sound. In addition, components produced in a variety of media and software applications are easily integrated into Authorware (without loss of quality) and provide users with a consistent interface across a variety of applications. It is also possible to export courseware produced in Authorware Professional to an IBM PC or clone (with some loss of features).

It is envisaged that the variety of stimuli and user friendliness will provide students with a highly motivating learning environment. The use of windows, icons and a mouse allows students to complete many learning tasks without using a keyboard, minimising the need for computer literacy and extensive keyboard skills.

PREP has invested substantial resources to develop appropriate CAL Instructional Systems Design protocols to ensure quality assurance procedures for courseware development. This was seen as being vital because courseware is to be developed by a number of institutions throughout the State. The CAL protocols are being developed by a number of higher education institutions in Queensland and focus on all aspects of instruction design, including screen specifications, authoring templates and training.

The Authorware Professional software facilitates the development of learning materials because the WYSIWYG environment avoids complex programming and makes CAL more accessible to writers, designers and other materials development team members.

The Future

At this time PREP will be fully developing subjects in Mathematics and Communications/Studies Skills as well as developing supplementary packages for Chemistry and Physics. The instructional design strategy is integrated within a framework that facilitates cooperation between various higher education institutions. It is intended that this is the first phase of the project and more materials will be developed as funds become available. In the second phase of the project, through the OLCN, PREP will develop more preparatory and remedial courses and investigate the use of Computer Managed Learning systems.

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Teaching with Telematics: It's not as hard as it looks, or is it?

Ian Conboy
Ministry of Education, Victoria

Teacher attitudes and their level of professional preparation play a crucial role in whether an innovation is taken up in education. Within the context of The D'Cruz Report, 1990, *an evaluation of a project to use communication technology (referred to as telematics or audiographic technology in Victoria) to expand curriculum choice in rural post primary schools in Victoria in order to encourage students to stay longer at school (Resource Agreement 3 — Country Student Participation), an examination is made of some teacher attitudes. Clearly practical issues have been important influences on the relatively small number of teachers who have used communications technology. If communications technology is to be mainstreamed into education delivery where the need exists, then much more attention has to be given to teacher preservice education in communications technology and their continuing professional development.*

Teacher attitudes play a crucial role in whether an innovation is taken up in education. Surprisingly, little attention seems to have been given to the nature of the classroom environment and how teachers integrate educational change into what are relatively firmly established educational procedures. This paper examines some thinking about what influences teachers to accept or reject change and it then looks at some teacher attitudes to a project to use communication technology (referred to as telematics or audiographic technology in Victoria) to expand curriculum choice in rural post primary schools in Victoria in order to encourage students to stay longer at school (Resource Agreement 3 — Country Student Participation). This joint Commonwealth and State Government project allocated $3.[illegible] to seventy-nine small, relatively isolated rural schools in Victoria to equip them with communications equipment, software and courseware. Schools were expected to form into clusters across Victoria and use communications technology to share scarce teaching resources. The project required a significant departure from teachers' established teaching procedures for them to use communication technology to teach students in neighbouring schools in a distance education mode. An evaluation of the project was commissioned in 1989 (The D'Cruz Report, 1990), and this paper is one of a series which will highlight issues which have been highlighted in the report. Why some teachers chose to become involved with communication technology and some did not may provide valuable guidelines for implementing similar innovations elsewhere.

Practical considerations in determining teacher attitudes to new technology

Educational systems while notionally appearing to be bureaucracies function in a much less coordinated way. Teachers, particularly in Victoria have a large amount of classroom autonomy. Rarely if at all is their work supervised in the classroom by another educator. Generally, the classroom door is usually closed and only on infrequent occasions is it opened to visitors. Teaching strategies such as team teaching have not been taken up universally partly for this reason. Nevertheless, new communication technology with its audio, video and computer conferencing capability opens the classroom door and places teachers' work under more scrutiny from their peers. One would expect that this technology would be more successful in those locations where their educational need is readily apparent, and where teachers are able to develop close working relations and mutual cooperation to implement these delivery modes. Such conditions are more likely to be found in small rural schools rather than large metropolitan schools.

One important practical consideration influencing whether teachers use communications technology is their level of preparation. The D'Cruz Report highlighted the importance of preservice and inservice professional development in a range of delivery systems as well as taking full advantage of telematics (communications technology). Recommendation 7 of the report states that

> *the Ministry further encourages its own relevant professional development and other agencies, and the teacher education institutions in Victoria, to provide an adequate inservice education in a range of delivery systems, including telematics; and to take full advantage of telematics to deliver courses where appropriate,*

and Recommendation 11 states

> *that, as a matter of some urgency, the Ministry encourages teacher education institutions in Victoria to provide pre-service education in a range of delivery systems including telematics through their Diploma of Education courses.*

The importance of effective professional development on teachers' attitudes towards using communication technology in education is conveyed in the report. Sixty-one per cent of teacher respondents involved in the project indicated that they had taken part in a professional development activity and nearly fifty per cent of them indicated that their training had some impact on their participation in project initiatives. Conversely, nearly eighty per cent of the respondent teachers sampled in the evaluation study and who have not been actively involved in project initiatives indicate that they had not received formal training in the use of communication technology (telematics).

In relation to the content of professional development courses, there was a plea from respondents that those conducting inservice education courses should include experienced telematics teachers as facilitators. They also felt that there should be an emphasis on the development of confidence and self esteem amongst teachers in the practical use of equipment. Contextual issues such as the notion of sharing in a rural environment and links between technological changes in society and education should also be included in professional development courses. Respondents suggested that inservice workshops that went beyond 'wires and switches' to include curriculum based issues were very desirable. Clearly, access to training which extends beyond practical issues is crucial. Practical issues should be seen in the context of an educational framework which in the case of Victoria's Resource Agreement was the need to expand curriculum choice for rural students.

Apart from the level of teacher preparation, the nature of the innovation process in schools is determined partly by circumstances (e.g. access to expertise, available finance PTA support) and partly by any innovation's capacity to persuade teachers of its real worth in terms of the need for it, its innate worth and its practicality (Wright, 1987). Teachers need to see a purpose to any innovation in a way which ascribes a place for them and a function. Both the need for and innate worth of an educational innovation tend to be subject and context specific. However, teachers' notions of what is practical for classroom use and how this leads them to view an innovation are far more transferable between innovations and worthy of detailed study.

Their willingness to adopt new ideas has something to do with the way they are implemented and the practical nature of teaching as well as the nature of educational organisations and teacher orientation to change. Teacher behaviour tends to be influenced by what is practical in the classroom (Doyle and Ponder, 1977-78). They tend to modify new innovations to fit their classroom procedures; they adapt rather than adopt. Technical expertise and professional competence are acquired by a process of trial and error and assimilated into existing classroom practice. They seem to add on new elements rather than reconstruct curriculum patterns (Wright, 1987).

Teachers describe their work in individualistic terms which reflects the uniqueness of each classroom; they tend to be concerned with immediate outcomes and this is reflected in their concern for student outcomes rather than long term gaols. Their decision making is oriented towards the concrete and procedural rather than the abstract and general. The complexity of classroom often makes a mockery of prior educational trials in "controlled settings". Innovations which ignore the classroom setting and how teachers behave in that setting generally fade away usually when funding starts to taper off. In other words, teachers are practical individuals largely governed by the contingencies of having to teach large groups of non-volunteer students over long periods of time.

The notion of practicality for teachers is largely influenced by three criteria: instrumentality, congruence and cost (Doyle and Ponder, 1977-78). Instrumentality relates to how well an innovation is described in concrete procedural terms as well as general goals. Doyle and Ponder suggest that teachers often complain that new innovations are seldom communicated clearly and this appears to be directly related to the absence of procedural content in the description. Congruence describes the extent to which the proposed change is similar to teachers' own perceived situations. It tends to be determined by three things. Firstly, how closely the procedure proposed fits in with the current way the teacher teaches in his or her classroom. Secondly, the origins of the proposal and finally, the compatibility of the proposal with teachers' self image and preferred mode of relating to students. The cost measured as the rate of return from a given amount of investment is the final factor determining the practicality of an innovation for teachers. This issue is far more complex than might appear in the first instance. There is some evidence that teachers will adopt innovations despite some scepticism about its personal cost if there is some reward for innovation. This does not necessarily have to be monetary remuneration. Recognition from peers and administrators and student enthusiasm for the innovation may be sufficient (Stephens, 1974).

Educational innovations in schools involving technology are different are different in some respects to other curriculum innovations. Inevitably, they tend to be more costly; teachers as a group may have a lower knowledge base at the beginning of the innovation, some students are likely to be well informed about some of the technology particularly computers and there may be some negative social and cultural attitudes about technology generally which may not be part of other curriculum innovations. In discussing the factors which influence teacher responsiveness to change in educational technology, Kefford suggests three: the uncertainty which exists regarding the development and evaluation of new educational technologies; the organisational characteristics of the school in which the teacher works and the teacher's perception of his or her role (Kefford, 1983).

Seemingly endless rapid technological innovation can have a number of diverse effects on teachers and administrators. It can act as a stimulant to that relatively small minority of teachers who either become interested in the equipment or the software. In one sense, the technology is like a stamp collection with adherents vying for the latest equipment or software. On the other hand, some teachers may be bemused and completely disenchanted by the rapid change. They might consider learning how to use it futile in the light of rapid advances or use the ploy of postponing any investment in terms of money and time until a new improved version becomes available. Administrators might be reluctant to invest in equipment which can through a technical development, suddenly depreciate at an alarming rate or be completely superseded. Notwithstanding the rapid improvements in communication technology, the educational requirements of teachers often outstrips the capacity of technology to provided them. Teachers' lack of understanding of the technical problems involved in trying to meet their requirements may lead to disillusionment and frustration with technology. Very little technology is designed solely for educational markets and often 'instant solutions' are not available. Introducing technology in a school situation can often be a tenuous process of trial and error.

Organisational characteristics of schools have a big influence on teacher attitudes towards using technology. Schools which are prepared to change class times to coincide with timetables in other schools can smooth the way for teachers to use communication technology to teach students in neighbouring schools.

However, Kefford suggests that the most critical element is the teacher's own perception of role in relation to technology. Gilcher and Johnstone surveyed nine major tertiary users of audiographic communication systems in the US and Canada including

Knowledge Network in Vancouver, University of Calgary, Utah State University and Boston University School of Medicine in relation to teachers' perceptions of audiographic technology (communication technology) and concluded

> *It is not surprising that faculty members who volunteer to teach on an audiographic system are more satisfied and more successful than faculty who are assigned to teach on the system. It is also the case that the volunteers who are given greater amounts of preparation time seem to feel better about their performance than those with less time. Other critical variables that affect the instructors' attitudes include: availability of on-going technical assistance, help in "translating" their courses into distance modes, prior practice on the system, good quality audio equipment, administrative or peer recognition for their efforts and the level of training that the student users of the system have had. (Gilcher, Kay W. and Sally M. Johnstone (date unknown)).*

In a revealing case study, one US teacher documented a range of concerns about computers (Office of Technology Assessment, Congress of the United States). Inservice education programs delivered too fast and accompanied by confusing manuals; deep scepticism about the purpose of computers — "What's it for?"; a desire to preserve the "performing" aspect of the job and seeing computers intervening between teachers and students to prevent this; a concern that teachers relinquish their instructor role to become mere facilitators and a concern that students will lose valuable feedback from teachers if they resort to large scale drill-and-practice sessions provided by computers.

One means of overcoming at least some of the above concerns is to involve teachers themselves in the planning process. Naisbitt refers to this as the high tech/high touch approach (Naisbitt, 1982). Most technology innovations are introduced by 'high tech' people in the sense that they have a strong interest in the field. High touch techniques are interpersonal activities goal setting, self evaluation, group meetings and so on. For a successful introduction of technology in schools, there should be a balance between the high tech and high touch approaches.

Teacher involvement in implementing Victoria's resource agreement 3 — Country student participation

Teacher involvement in the project was not mandatory. It was left to individual clusters of schools to identify their curriculum needs and then approach the teachers in the cluster to see if they were agreeable to use communications technology to teach students in neighbouring schools as well as students in their own school. Initially in the project, individual teachers in the Mallee Cluster were consulted about what technology they would require to teach effectively in the hub-class-to-remote-student distance mode and were strongly involved in final choices (Loddon, Campaspe, Mallee Regional Technology Group, 1987). One of the main factors governing the operation of the project was the participation of teachers and Principals in setting goals and directions for the program within their local districts. At the outset, planners were determined that schools would decide how they could use technology in their own settings. While alternatives such as using satellite to mass educate rural students were theoretically available, they were rejected on the ground that they would disenfranchise schools and teachers from key decisions about how they would apply technology. It was also felt that at this time in the Ministry's development, teachers and students required low cost technology which they could use and learn on themselves. One of the characteristics of computer technology is the willingness of many teachers to teach themselves (Grundy et al, 1987). The teachers indicated that they required voice, document and a remote electronic blackboard links. They sought to create when teaching students in another school, a teaching environment as close as possible to their normal working situation. Even though, for the majority of teachers using the technology, decisions about the equipment and software to be used were made centrally, some advice was obtained from them about the performance of the equipment chosen. Voice and facsimile links were provided readily as proprietary products existed on the market. However, creating an electronic blackboard which allowed both the teachers and their students in neighbouring schools to 'write' on it proved much more difficult to achieve (Elliott, 1989). Macintosh computers were selected as the most appropriate vehicle because of their graphics capacity and relative ease of use. Graphics tablets and modems were attached to the computers and a variety of software was tested to determine what would combine reasonably legible images with an adequate speed of transmission and ease of use. Towards the end of the third year of operation, the problem was resolved.

Approximately fifty teachers used the audiographic links to teach or tutor students in cluster of schools during 1989. The system was used in two ways. Some preferred to plan their 'blackboards' in advance and save them on computer disk. These teachers naturally worked particularly hard during their first year of using the system. Others preferred simply to treat the mode as they would a normal class environment and use the graphics tablet to explain visually a point they were making during the lesson. They would then invite students to join them in using the 'blackboard' to modify or embellish the work already on the screen.

Teacher use of telematics for instruction — some observations

One of the crucial questions facing planners of Victoria's use of communication technology in rural schools project is whether after nearly three and half years of use teachers as a group see a need for telematics and if they think it has innate worth and are convinced of its practicality.

Whether teachers as a body in rural schools see the need for communication technology is in part determined by their perceptions of other Ministry policies such as district provision. Using communication technology is seen as one of several strategies to be used by small rural schools to provide a richer choice of curriculum. Other alternatives include travelling teachers, flexible staff deployment within schools, composite classes at lower levels and so on. In addition, the location of the equipment in small storeroom type locations has tended to relegate the use of communications technology in instruction to the periphery of school activity. Certainly, perception of need is a crucial factor determining involvement. When a sample of non-involved teachers was asked for reasons for not being involved with project initiatives, seventy-one percent of those responding indicated that their school simply did not require them to be involved (D'Cruz, 1990). This suggests that school administrations do not perceive the need for telematics to provide a wider curriculum and maybe do not see providing a wider curriculum as having much impact on retention rates in rural locations. Initially in the project, there was some quiet questioning of this assumption but recipient schools perhaps not wishing to jeopardise their involvement did not pursue the issue.

In relation to the question of total teacher perception of the innate worth of the communication technology used, no reliable data exists for the teacher population in isolated rural schools as a whole. Informal observations would suggest a degree of scepticism but informal discussions with teachers involved with the project suggest that this is slowly breaking down. One of the key factors causing this change of attitude is the positive student reaction to the technology which teachers notice and the successful results obtained by students when they use communication technology for part of their instruction (Education Victoria, February 1990).

Whether teachers see communications technology as a practical solution appears to vary considerably with each individual and how they proceed to use it. In relation to its instrumentality, that is, the degree of concreteness of the innovation, once again it is difficult to obtain a general conclusion for teachers as a whole. Because of the innovatory nature of the project, it is fair to say that most advice provided to teachers using communications technology was general in nature apart from some excellent hands-on training activities with equipment and software. Individual teachers developed procedures for integrating technology into lesson structures and these were compiled into a booklet and distributed to participants of one professional development activity (McNamara, 1988). There is a growing awareness of the importance of concrete procedures to teachers and they are beginning to develop these themselves (Behrendt, 1989).

The project appears to be relatively congruent with teacher perceptions of their role. Although superficially, the task of teaching with an audio terminal, a facsimile machine and a computer used as a remote blackboard appears daunting, all the teachers who used the system in 1989 were prepared to continue using it again in 1990. Seventeen of the twenty-three teachers who responded to the evaluation of the project as practising users of the communications technology indicated that using it made them more effective as teachers (D'Cruz, 1990). These finding are obviously influenced by the context in which teachers in general use the technology. Most teachers link small groups of Years 11 and 12 students in the remote sites. These students are motivated and responsible. Where communications technology has been used with large groups of younger children in the remote sites, extraneous noise levels interfere with the audio link and detract from the quality of instruction (O'Grady, 1990).

Congruence is also influenced by the origin of an innovation. In the case of this proposal, the technology has to be seen as appropriate for rural locations and capable of addressing rural problems. While the project was premised on groups of schools identifying how they could enrich their own curriculum to improve the student retention rates, the reality is that only about six teachers were directly involved in selecting or modifying the communication technology used in the project. From time-to-time, other teachers using the audiographic system provided verbal advice, delivered sessions at professional development conferences and contributed articles for publications but they were not involved in initial decisions. However, because of its close links with the Country Education Project approach to rural education, it is likely that teachers saw the project as in general being congruent with their own situation. A body of knowledge is developing in Australia related to applying communications technology in rural education and several government reports have focused on this issue during the eighties (Australian Education Council, 1985;. Commonwealth of Australia, 1989)

The project has had a positive impact on teachers' self image and their student relationships. Teachers have indicated that the use of communications technology creates a certain amount of informality with students which is helpful for personal relationships (Lipscombe, 1988). There is a feeling of learning together which is in part due to the novelty of the innovation.

The personal costs of being involved with the project did not outweigh the benefits gained by students according to most teachers (D'Cruz, 1990). These include a greater degree of independence, improved organisation skills, a greater willingness to ask questions and take part in discussions, improved diction and an awareness and concern developing among face-to-face students for their distant class members. Because the group surveyed includes teachers who made extraordinarily heavy commitments to developing technology studies resources (tekpaks), it is likely that most telematics teachers did not consider the effort of learning to use the technology to be a constraint. In the evaluation of the project, one of the most frequently quoted unanticipated favourable outcomes was the large amounts of professional satisfaction obtained by staff (D'Cruz, 1990). On average, teachers involved in the project either through developing resources or teaching students with communications technology have fourteen years teaching experience. For many of them, the Resource Agreement came at an opportune time in their careers when they were looking for fresh challenges. For some, it meant an opportunity to continue teaching their most cherished discipline. Others grasped the opportunity to communicate with other teachers and saw the professional isolation of working in a small remote country town start to disappear. In general, for those teachers who had the confidence in themselves and their students to use communication technology, it appears to have been a professionally rewarding experience.

Teaching with communications technology is probably as hard as you care to make it. It can never be the same as face-to-face teaching, even with some expensive technology added to provide fully interactive television. It is not a substitute for personal contact and in fact, regular visits between teachers and students are an integral part of the Victorian project. These help to break down the inhibitions which might otherwise be present and help to develop the learning partnership which seems to be a feature of Victorian teachers' procedures. Remote teachers can never handle large groups of young students without strong on-site support and then this brings into question the cost effectiveness of using communications technology. The very opportunities opened by technology can create more work for teachers and make the job harder initially (Congress of the United States: Office of Technology Assessment). However student gains seem to make it all worthwhile. Students from Southport State High School in Queensland reporting on their Telelearning German Project suggest that they have been forced to become more self-motivated: they have had the opportunity to work with modern technology and have developed skills of cooperation with others and group interaction (Upson *et al*, 1990). Similar comments have been made by some of the Victorian teachers interviewed by D'Cruz (The D'Cruz Report, 1990).

Conclusion

Doyle and Fonder's analysis provides a useful framework for looking at teacher reaction to using communications technology for teaching students in neighbouring schools. However, practical issues should be considered within a wider educational framework which must to be spelt out in detail. Where they exist as ends in themselves, they can lead to a negative form of instrumentalism which can be harnessed to any end. Clearly practical issues have been important influences on the relatively small number of teachers who have taken up the challenge to use communications technology in Victoria's rural schools. However if teachers are to become equally as competent with communications technology as they are in a conventional classroom and it is to be used to provide a curriculum which provides a high level of interaction between the teacher and students, then much more attention has to be given to teacher preservice education in communications technology and their continuing professional development.

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Computer Based Training and the RAN: Shipboard Training

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HMAS Cerberus

The Australian Defence Force has been researching and developing CBT programs since the early 1980's. As a part of these developments computer trainers and simulators have been in use for some time in the Royal Australian Navy. With the growing trend towards CBT in the defence force, and in particular in the Navy it is perhaps timely to examine some of the lessons learned from projects undertaken. The example used in this paper is one such project.

Traditionally shipboard job training has been conducted through the use of task books, whereby allocated tasks are stated in a book. Upon successful completion of these tasks trainees are signed off in the task book. Once the task book is completed and signed, the sailor progresses into the next phase of his training. Computer based training was proposed as a more efficient and effective means of conducting such training for a number of reasons:

- CBT as a training delivery system was anticipated to be more efficient than the more traditional methods because it did not rely on persons other than the trainee for training to take place.
- It was perceived that CBT would be applicable in that it was a self-paced course and that sailors were not lost to training in other parts of Australia. Theory training and on the job training, in this case, were in close proximity.
- It was anticipated that by making the program self-paced it would ultimately individualize instruction and therefore eliminate the extensive use of an instructor.

The Project

In 1985 a team of two training developers were tasked with meeting the training needs of the then new Auxiliary Oil Replenishment (AOR) ship — HMAS Success. Contrary to normal practice the two were assigned *prior* to the ship becoming operational. Two specific areas of on board training were selected for the project to be conducted on board HMAS Success — The Damage Control Console (DCC) and the Controlled Pitch Propeller (CPP) Systems.

Console operation is extensive in the Navy. The aim of the development of the computer based instruction on board the ship was to provide a trainee with the ability to reach a high level of proficiency in operating the Damage Control Console without seeing the console itself. The CBT was a simulation of the DCC. A second objective of the project was that the trainee should be able to reach this proficiency in his own time and at his own pace and more importantly both the training and simulation take place without the need for instructors or simulator operators in attendance.

The second system selected for the development of computer based training was the hydraulic system (CPP) on board HMAS Success. It was intended that the CBT developed for this system should allow a trainee to undertake such interactions as looking at the equipment and 'seeing' what is happening, referring to screens illustrating cut-away diagrams of each major component in the system or viewing such features as the graphic representation of the oil flow. An advantage of the proposed CBT for the specified training was its capacity to allow a student to choose to work with a particular component or the whole system operation.

The Computer Based Training Development

The CBT package *Coursemaster* was selected as the development and delivery package for the project. This package uses a slightly modified IBM personal computer as the design and delivery mechanism. The courses used on board HMAS Success were developed at the RAN School of Training Technology at HMAS Cerberus and at the Training Technology unit in Sydney. The adopted style of training was a team approach. All departments were to assist in the new training program, allowing sailors to be released from duties to attend CBT sessions.

Lessons Learned

In terms of training, the Royal Australian Navy (RAN) for one, evaluates training in relation to its *effectiveness* and *efficiency*. Effectiveness being the degree to which training prepares people for the specific task, and efficiency being the relationship between the effectiveness of training and its cost, that is the extent to which training achieves its objectives in relation to the expenditure of training resources. Ultimately, effective CBT can only be developed if we learn from the our mistakes and those of others. The following summarises some of the findings of this project:

- The training developers undertaking the project for HMAS Success were introduced to new concepts of training development, namely training was to be specific for a single new ship. The training materials designed to be used with *Coursemaster* were developed specifically for the systems on board HMAS Success, ultimately directing policy that all formal training was to be conducted on board.
- Learning to author computer software effectively took two weeks of formal training plus extensive on the job training, therefore time was needed for this was at the expense of other work which at times would restrict operational tasks.
- It was found during the course of this project that while determining learning strategies, close liaison with the likely training implementers was imperative not only to ensure that the design would work but also to assist the acceptability of the design of the programs by the crew. The crew provided the appropriate feedback on the accuracy of the materials.
- A major problem confronting the training staff was the time lost when piloting the training materials. When collecting job related information the absence of people performing or supervising jobs hampered

the efficiency of the training. Due to manpower shortages, limited job exposure of appropriate subject matter experts was available. It was quite difficult to design training materials that would use manuals as authoritative aids when those publications were not developed beyond draft form. Consequently equipment and procedure manuals were being written at the same time as being required for training development which provided even longer delays.

- The required environment for CBT formal training is a quiet area suitable for study purposes. HMAS Success like all ships, is designed without this consideration, which ultimately complicates the effectiveness of the training task and hence defining the areas suitable for this role on a ship.
- Formal training implies instructor or supervisor involvement. However due to the roles of the crew members of HMAS Success such involvement was quite impossible.

Recommendations

Upon evaluating the problems that this project confronted, the following recommendations were made.

- A qualified training developer is required to join the project, with the first of a standby crew, who would be able to assess the training requirements and organise a plan of action.
- It is necessary to determine at an early stage of the project the crew's ongoing training needs and how they could most efficiently be met.
- Appropriate preliminary data collection should be done to gather and process training related data and materials and develop Australian based training courses and resources.
- To be able to effectively produce the required materials it is necessary to liaise with other training authorities on an as required basis.

The situations mentioned above have probably occurred before the HMAS Success project and may occur again in the future, possibly the next being the submarine training project. It is therefore appropriate that we learn from and remember these experiences. It is probable that the situations and experiences realised throughout this project are not peculiar to the RAN. The perception and actualisation of CBT effectiveness in RAN ships is a major task; one which is still being researched, designed, developed, quality controlled and validated. If Computer based training in the defence forces is to fulfil its potential we must continually take time to pause and reflect — is it really the answer or is it just another filing cabinet gathering dust?

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Computerised out-of-class exercises

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Students' access to, and knowledge of material databases can have an enhanced effect on the teaching of materials to engineering students. Most engineering subjects taught at tertiary level are usually mathematically based and students are normally familiarised with lecture material via mathematically based tutorial problem solving. Engineering Materials as taught at Chisholm is mainly non-mathematical and, as such, easy to set mathematically based tutorial problems are not generally applicable for reinforcing theory. It is proposed that computerised materials databases can be used in a variety of ways to both reinforce lecture theory and acquaint students with the vast spectrum of material property data available. In fact, it can be argued that the teaching of engineering materials cannot be effectively performed without students having sufficient access to materials databases. To develop an appreciation of the applications of the theoretical concepts developed in Engineering Materials lectures, students need the feedback associated with materials databases.

Commercial Materials Databases

Engineering students at Chisholm use the materials database of the Australasian Institute of Metals and Materials (IMMAMAT) (Phelan, 1988), which has been developed by the author. This database contains over 500 generic alloys and over 500 internationally cross-referenced standard alloys. It occupies about 1.5 Mb of disc space. The students are set exercises which require them to become familiar with the basic concepts of the material defining parameters used in the database.

Immamat Student Exercises

1. A simple exercise.

Selection of a material to make an axle. The axle is to have a specified strength.

Even for this apparently simple exercise, a variety of tasks are required of the student. Some of these tasks are:

a. Finding alloys in the data base which are described as being suitable for axles or shafts or spindles etc. That is, the student may need to think of other descriptors or components that could have similar functions.

The software used to construct the database contains a pattern-matching algorithm which allows for searching through the alloy text fields to obtain approximate matches to the search string. For instance, if "corrosion resistance" was being used as the search string, then an alloy described as "corrosion resistant" would be found by the search.

b. Find alloys that have strengths equal to or greater than that required. The database allows for searching using minimum and maximum mechanical properties.

c. Choose which type or types of alloys to search through; cast iron, heat treated steel, wrought aluminium etc.

Irrespective of which search path is chosen, several solutions will be presented and the students will be required to make a selection which will involve the use of theory gained from lectures. In the above example, steels having a variation in strength with section size will be presented to the student. The significance of this will need to be interpreted by the student. In fact, it is the author's experience that even though the theory associated with variation of strength with steel section size has been covered in lectures, most students will query it when the data is presented to them within the environment of what they perceive to be a large industrial metals database. That is, they are impressed with the presentation, feel it is part of the real world as opposed to the unreal world of the academic classroom and subsequently take more notice of it. It may be, of course, that in being allowed to work at their own pace, as opposed to keeping up with the delivery of lecture material, they are in a much better position to assimilate and query the data being presented to them. Some students do remember or have studied their lecture notes and the presentation of the computerised data helps to reinforce their knowledge.

The above is a simple example of a material selection problem and the level of difficulty of the problems set may be varied to suit the standard expected of the student.

2. A more demanding exercise.

A material is required for the manufacture of a light weight complicated section. The light weight section is to operate as a sliding mechanism at a variety of temperatures.

The student is required to translate the above functional requirements into the following material property requirements

a. light weight — aluminium, magnesium or titanium alloy

b. complicated section — casting alloy required

c. sliding mechanism — wear resistance advantageous

d. varying temperature — low thermal expansion to prevent jamming

Again, a variety of search techniques can be used by the student who would be expected to find aluminium casting alloys with relatively low thermal expansion and relatively high wear resistances. These alloys would be suitable for the manufacture of internal combustion engine pistons.

3. Cross Referencing of Specifications

A common industrial engineering materials problem occurs when specified standard materials, Australian or international, are not available locally. Commercial databases may supply other equivalent materials.

Students can be given Australian or International standards and be asked to find equivalent alloys.

Non Commercial Databases

Programmes have been developed that randomly simulate material selection problems requiring an input from the student. The programme uses a materials database which the student is expected to be vaguely conversant with. Properties are randomly generated and displayed. The student is then expected to input a material which will satisfy the displayed properties. Some materials are more acceptable than others and receive a higher score. The programme has a game format and subsequently presents a challenge to students to score as high as possible.

Students are given a broad outline in lectures of the material properties involved in the database and are then expected, through library research etc., to obtain the specific knowledge required to input suitable materials to the programme. For example, after a series of lectures on stainless steels, students would need to consider the chemical composition of the steels in the data base to rank them in order of corrosion resistance. Amongst other properties, the programme will ask for a steel having a certain minimum corrosion resistance. Students receive a score for their overall game performance and this score is recorded against their name on the floppy disc containing the programme. At the end of the exercise the disc is returned to the office and the student's scores are recorded. Suitable encrypting of scores, etc. prevent any tampering with results. Students seem to go out of their way to complete the exercises and may be motivated by the need to see a score recorded against their name on the floppy disc which is to be returned to the office. A more detailed description of this and other similar programmes has been given elsewhere (Phelan, 1989).

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The impact of high touch in the high tech world of education: An issue revisited

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As the content and the tools of teacher education become increasingly technology-based there is a residual effect possible the dehumanization of instruction. The use o£ computers, videodisc, and other interactive technologies, when appropriately planned for within the context of instructional design parameters, can offset the tendency towards dehumanization. The problem, however, lies in whether or not ISD is incorporated in the preparation of instructional materials. It frequently is not. Concomitant With the need to incorporate an appropriate ISD model is the need to "know" the diverse learning/information processing styles of our learners.

Over the years the Meyers Briggs instrument has been used to identify extant "types" of personalities. With its sixteen different cells, progress has been made in assisting learners make vocational and personal decisions. Don Lowery took the sixteen Meyers Briggs classifications and "reduced" them to four basic ty[illegible] called "true colours". Based on the concepts presented within the framework of True Colors, each participant will identify their own "true colours." Once this has been done the participant will then relate the True Colors information to the design of instructional materials and experiences, especially those which involve the use of technology.

When we were in Edinburgh we covered a multitude of information within a scant fifteen minutes—both the audience and we were exhausted! Now we ask you, is this any way to encourage the use of "high touch" in this whirlwind of technocracy which surrounds us!

We believe sufficiently in our message that we opted for another go at delivering it, and this time in Sydney, rather than dwell overly on the historical antecedents of how technology became entwined in how we teach, we'll simply provide a mental dash through time, lasting all of one and one-half minutes, and be done with it.

With any luck at all, we should have sufficient time remaining... all of it to address the far more critical issue of "How do we, as well as those we teach, cope with an ever increasing barrage of technostress?"

A number of options present themselves. All, however, revolve around one major individual—the learner! We'll state our "bottom line" now, should time prevent it from being repeated.

We who work in the educational technologies have the responsibility to insure that our every effort is designed to produce a learning experience which is as humanistic as possible. Doing so, however, requires insight into both we who teach (self) and those learn (others)!

Indeed, the field of instructional technology is becoming increasingly aware that, along with all of its near-requisite "bells and whistles," there must be an accompanying responsibility to insure that human needs are addressed as well.

Author, humanist, computer guru, Ben Shneiderman, given the problem of technostress as it applies to the computer-user (which increasing numbers of us have become) states:

> *Frustration and anxiety are a part of the daily life for many users of computerized information systems. They struggle to learn command language or menu selection systems that are supposed to help them to do their job. Some people encounter such serious cases of computer shock, terminal terror, or network neurosis that they avoid using computerized systems. These electronic-age maladies are growing more common; but help is on the way!*

> *...the diverse use of computers in homes, offices, factories, hospitals, electric power control centers, hotels, banks, and so on is stimulating widespread interest in human factors issues. Human engineering, which is seen as the paint put on the end of a project, is now understood to be the steel frame on which the structure is built (Shneiderman, p.v., 1987).*

If we are to speak to these "human engineering" needs we simply must learn more about the learner, who he or she is, and problems they currently face. Not to do so is pedagogically unsound but cruel as well.

The need to assess our learner's background, however, is predicated on the fact that, first, we must fit a professional profile which will facilitate our own entry into the realm of instructional design. In truth, it is simply not enough for us to adopt the code of "do as I say, not as I do." If there is to be a joining between instructor and instructee, there must first be some element of compatibility extant between the two.

What do we mean when we say this? We are saying, in as direct a way possible, that there are baseline personal attributes which the instructional designer should possess if he or she is to adequately pursue the design of materials for others. Kemp appears to say it best when he states:

> *Not everyone can become and instructional designer. Just as the work of a medical doctor or that of an airline pilot requires that a person possess certain personal traits and act in certain ways, so there are personality factors and behavior patterns which can indicate whether or not an individual could engage successfully in instructional development work (Kemp, 1985, p. 206).*

Following this statement, Kemp lists eleven traits which he deems important:

- *Willingness to assume responsibilities and make decisions*
- *Enthusiasm, with a sense of commitment to one's work*
- *Patience, combined with the ability to avoid frustration*
- *Persistence in staying with a difficult problem*
- *Interest in handling many details and organizing them into meaningful patterns*
- *Integrity and honesty*
- *The maturity to put up with resistance, resentment, and even obstructionism*
- *Good sense of timing, to know when to act and when to remain silent*
- *Willingness to innovate and try new things*
- *Willingness to admit mistakes and ability to say, "I don't know (Kemp, p. 207, 1985).*

Romiszowski, bridging our discussion of traits of the teacher/designer to those of the learner, examines the "missing domain" of the social, interpersonal, and interactive as applied to the act of designing instruction.

In this he indicates that, when it comes to interactive skills for the educational technologist, two tendencies from the past have conspired to impede implementation.

One is proffered by the various entrepreneurs who, confronted with what Romiszowski calls the "undefined and unanalysed area" [interactive skills], came forth with a variety of 'instant solutions', safe in the knowledge that it will be very difficult either to prove or disprove the effectiveness of their techniques.

We continue, to this day, to be bombarded with innumerable brochures which announce that, if one attend this workshop, one will become expert in "resolving employee dissatisfaction" ... "managing internal corporate conflict" ... "effecting higher motivation levels among the work force" etc. etc...

Opposing the entrepreneur mind set is, Romiszowski states, the second tendency—"a rejection of the technique(s) [as above] and of all connected with it by the 'scientific community', meaning those who like to see all things measured and reject anything that cannot for the moment be measured (1981, p. 219)."

Romiszowski concludes:

> *Thus there has been a tendency for educational technology to ignore the group dynamics movement and this has no doubt been helped by a philosophical polarization between the 'social education' supporters who are staunch believers in the process–oriented approach to education (and all that implies in the way of discovery approach to all learning), and the more dyed–in–the–wool educational technologists who want to have measurable products (objectives) defined for all learning and often find it hard to justify discovery methods on a cost–effectiveness basis (1981, p. 219).*

We are left, then, with a polarity of opinion, even within our field, as to what might be the "best" pedagogical approach to take where designing materials in a 'humanistic' manner is concerned. One group most definitely would include such a concern, the other most likely would not, seeing such as being not cost-effective nor necessary. It is to those in the latter group towards which we direct this paper.

Obviously, our prime concerns are two-fold, that of the teacher and that of the learner. Assuming that we meet the Kemp criteria previously stated, and that we do plan our instructional design along the lines of Romiszowski's discovery approach to teaching, how do we access the concerns of the learner; how do we insure that what we know of the learner is also what is best included within the instructional design? Let's take these questions in order of their mention.

How can we possibly get to "know" our learners, you ask? There are a number of various tests, scales, surveys, etc, which can shed some light on this mystical identification process and tell us a great deal about who our learners are.

To name three— the Meyers Briggs provides considerable information about the style of person each of us is. So too, does the work of Dr. George Manning at Northern Kentucky with his instrument, "Chocolate, Vanilla, or Strawberry — Which are You?"

Both offer considerable insight, to the teacher as well as to the learner, as to who one "really is".

A third instrument, one which we find most intriguing, was developed by Dr Donald Lowery and is named "True Colors". In fact, with the kind permission of Dr Lowery, we have reproduced a few of its questions and in slide format, his "true colors" cards.

I will now lead you through each of the cards and provide some sample questions which, even if in skeletal form, will provide a sense of where the True Colors materials lead.

True Colors is taken from rese[illegible] done on the Myers Briggs Persona[illegible] Type Indicator. Where the MBTI has a matrix of 16 types, True Colors reduces them to four gen[illegible] "color" types. Lowery indicates that most of us have at least one preferred "color" type of behavior and perhaps at least one secondary color. We are happiest and most content when allowed to operate from our preferred "color" mode of operandi. When the human organism is happy, content, in its preferred state, it will experience less stress and remain optimally operational. Therefore, using a format such as True Colors, may be one way to better understand our learner and keep him/her less stressed by high tech.

By understanding one's preferred style and attempting to design learning activities which allow our learners the freedom to use their preferred style of learning, potential stress and uneasiness will be greatly reduced. These "high touch" factors are important to keep in mind as we continue to develop "high tech" curricula. Designing materials geared toward the users preferences will better insure decreased burn-out and higher productivity.

Conclusion

Well, there you have it. scant period of time during which we've taken you from where you are into a truely mystical and intriguing world beyond.

We cannot turn back the hands of time, albeit, some of use might wish to. We cannot bury our heads in the collectivity of multiple sand piles and hope that all of this technology stuff will just go away. (We're sure that, at least for this group, such is far from the case!)

What each of us can do, however, is to rejoice in the knowledge that the world our learners might experience from this day forward, may well be one in which the "high touch" of humanity and compassion will take its rightful place beside that of technology in education and that both will emerge the better for having done so.

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Collected abstracts of other presented papers

The competitive edge in manufacturing — an interactive learning system introducing strategic planning in a manufacturing industry context

Mr.Jeff Clayton (Aptech Australia Pty. Ltd.), Prof David Lee (SA Institute of Technology), Ms Jane Elliott & Ms Leanne Renfree (The Authoring House), Mr. Nigel Russell (Aussie Vision)

The objective of this video disc is to provide a learning experience for users who wish to gain an understanding of the need for, and an approach to, strategic planning in a manufacturing environment.

The need for Australian industry to become more competitive internationally has been widely recognised. Analysis of manufacturing industry performance in the 1980s identified widespread deficiencies in strategic planning capability. The Australian Government through its National Industry Extension Service sponsored the development of a strategic planning methodology by Aptech Australia Pty. Ltd., technology management consultants. This methodology, known as "World Competitive Manufacturing" (WCM) has been disseminated by a number of workshops through Australia and a consultant accreditation process. This disc is an educational package designed to further assist the dissemination of the understanding of the need for, and an approach to, strategic planning in the manufacturing industry context based on elements of World Competitive Manufacturing. It is particularly suited to tertiary education environments.

The learning package features a company case study coupled with a tutorial on WCM and interactive help facilities. The interactive help facility is called a mentor base. In addition to giving formal definitions of terms it emulates a mentor by using illustrative examples drawn from the disc's inventory of slides and video clips and tests understanding of concepts via short exercises before returning the user to the point in the disc where help was invoked.

The design of a study aid for synthesizing instruction.

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Recent advances in computer technology have provided educators with a range of innovative delivery mechanisms including computer-based systems, interactive video, CD-ROM and others. The newer systems make it possible to incorporate text, graphics, still pictures, auditory information, and real motion sequences into a single module of instruction. However, along with the convergence of these technologies of instruction to be delivered via these systems. Charles M Reigeluth's Elaboration Theory is one example of an instructional design theory which proposes a set of guidelines for sequencing, synthesizing and summarising instruction.

In this study, the researcher used Elaboration Theory guidelines to develop a study aid called the synthesizer for a unit of study in genetics. Three groups of students were given either the synthesizer, an alternative study strategy, or a placebo to determine the effects of the synthesizer on student learning. The results indicate that synthesizers are an effective strategy for helping students achieve both knowledge and application level learning. The findings from this study are consistent with previous research on synthesizers and suggest that studying a synthesizer is a useful strategy for helping students learn the relationships between and among previously learned ideas.

Roll over Beethoven...

Margaret S. Allan
James Cook University of North Queensland

Presentation of work in progress on a project to produce an interactive audio package for the study of intonation. Prototype materials are being developed using audio recordings on compact disc as a speech database accessed via HyperCard and the Voyager CD Audio Stack which is used in the Voyager Company's Companion to Beethoven's Ninth Symphony. The project is being developed in conjunction with the School of English at the University of Birmingham, UK and Dick Fletcher's company, New Media Productions. 'Interactive Intonation' is a pilot Stage One which will power the development of multimedia packages for the study of English by Speakers of Other Languages.

Human-Technology Traffic Jams (or harnessing human brainpower is more than a matter of logic)

Sue McNamara
Monash University

When was the last time you got stuck in a traffic jam? Despite our relatively sophisticated transport system (some might debate the point), with its multiplicity of traffic signals and wealth of rules and regulations — traffic jams still occur (and more regularly than many of us would like) Traffic jams have become a daily ordeal which some enjoy, many accept as inevitable, most avoid as much as they can, while others have been deterred from ever venturing outside their own territory because of them. A similar picture might be drawn in relation to user and designer interactions with converging technologies.

The paper discusses some of the unique geographical and social features which might be encountered in the pursuit of integrated technology applications to instruction and learning and suggests the possible use of tourist guides, roadmaps, safety islands, speed zones and other driver assistance mechanisms which might cater to the wide variety of individuals, touring, on business trips or settling into a world of convergent technological applications to education.

UNINET - Optical Fibres in Support of Research and Learning

Professor Trevor W Cole
Electrical Engineering
University of Sydney

Linking together Sydney University, University of New South Wales, Macquarie University and the University of technology, Sydney in cooperation with Telecom Australia, UNINET is offering unique capabilities. With multiple fibres installed and with the capability of carrying multiple signals on each fibre, UNINET will permit open-ended communications capabilities and will provide an environment well in advance of what might be available in the general network.

To offset the communication charges, the universities are entering three main agreements with Telecom Australia to undertake demonstration, use and research into the use of UNINET in an academic learning and research environment. The first is for the dissemination of broadcast quality TV material. The second is for fully interactive, multiple site videoconferencing. The third, and more for the future, UNINET will be used as a research and development basis for a fully digital, very high speed network carrying all the traffic of the first two agreements, as well as other traffic services, in a digital form.

"What's in a name! That which we call a course by any other name would smell as sweet"

James H. Strain
Victoria College

Following a major revision of course content, the former Graduate Diploma in Educational Technology conducted at Victoria College was reaccredited in December, 1989 as a Graduate Diploma in Instructional Design and Technology. This paper will pursue the significance of the course's name change and explore the distinctions identified between the role profile of an instructional designer and an educational technologist. The author will outline some of the fundamental changes necessary in providing a graduate diploma program for instructional designers as compared to educational technologists.

The use of the satellite and teleconferencing in real estate distance education

David Harrison and Kay Trowbridge

The pilot project was based on a concept of educational packaging, that is, use of satellite broadcasting, telephone conferences and print support material. The students were situated at three locations. Twenty were at Nambour, twelve at Mackay and one at Daintree. None of the students was able to proceed with the Award course in Real Estate at their local country college, either because there was no specialist lecturer available or student numbers were not sufficient to form a class. The technologies were chosen for the following reasons:

- Satellite broadcasting was to provide a focus for subject content and consistency in content.
- The videos were pre-taped, to allow five to six semesters of repeat broadcasts and thus minimise costs for production and broadcast.
- Telephone conferences were to provide administration updates, tutorial discussion and interaction.
- Print material was prepared for reinforcement of principles and revision.

The videos were produced with introductions, objectives and summaries. Slides were used to simulate field trips to specialised categories of real estate. Graphics were a focus for retention of principles and new terminology. The talking heads sections of the Property Management series were made more educationally interesting by having the interviewer's questions run across a black band at the bottom of the screen. It was expected that this would assist the students to more readily retain the principles raised in the questions. The tutors' experiences indicate that a great deal of preparation and ongoing flexibility are required in the delivery of educational packages. The problems encountered and strategies used to overcome the problems are outlined below.

Resistance to Technology and Different Accommodation

Some students in the larger group at Nambour did not respond well to the technologies. It was realised that the group was too large and should have been limited to ten or twelve. The accommodation was not physically comfortable. It made viewing the television uncomfortable and there was not sufficient space for students to be able to relax in a one-to-one, hour telephone tutorial. Strategies in telephone conferencing were developed, whereby students at one location were given tasks to do in small teams, and were then taken out of the telephone conference. The students at the remaining location/s were asked to respond to short answer type questions. (These strategies are explained further under Telephone Conferencing). Such strategies allowed the students to move around and be active, rather than passively responding to questions. The group of twelve at Mackay had comfortable accommodation and responded well. The one student at Daintree soldiered on, holding a household telephone for more than an hour. That student was highly motivated!

Satellite broadcasting

One of the problems with satellite broadcasting is that most people have to travel to a centre with a receiving dish. The Daintree student was the only one to have her own dish!! There were problems with this too because the signals are all encoded. That is, only those receivers authorised to receive can do so. On one occasion Daintree did not receive the broadcast. It is assumed that their B-Mac serial number was not programmed and transmitted that night. They were sent a videotape of the broadcast to compensate for the lack of reception. The lack of reception facilities is highlighted in a survey just completed of QDEC students to assess the level of their technology, the results of which are tabulated below. It should be noted that 0.9% have satellite dishes, the other 99.1% must travel to a receiving centre! A further problem occurred when an electrical storm over Mackay prevented that location from receiving the signal. Again, it was necessary to post a videotape of the broadcast.

Unfortunately, loss of the signal and picture made the following telephone conferences rather difficult, because the tutor had to deliver a mini-lecture to cover the lost work. These problems could be overcome by using a different delivery method, for example posting a videotape or using videoconferencing. An additional problem was that the students at Nambour lost concentration when viewing the twenty to twenty-three minute broadcasts and regarded some broadcasts as superficial. This was not the response at Mackay and Daintree. It was probably a direct result of the uncomfortable viewing conditions, that is twenty people viewing a television screen. One of the tutors observed that few students at Nambour made notes during the broadcast, an indication that they had switched off. A further complicating factor was that the students were employed by many different Real Estate Agencies, and in covering the course material, when asked to do certain application work were reluctant to give more than an obvious superficial answer, because they did not want to give away trade secrets to their opposition!

Telephone Conferencing

As has been mentioned the satellite broadcast was followed up immediately with a teleconference. There were three centres, one at Maryborough with twelve students, Daintree with one student and Nambour with twenty students. It is considered that this latter number is too many at one location to adequately cater for and control and did lead to some discipline problems. The technology used for the conference was a Confertel five line teleconferencing bridge supported by an NEC AE400 line echo cancelling loud speaking telephone system. The units at the other points were NEC Voicepoint loud speaking phones at Nambour and Maryborough and a standard Telecom telephone at Daintree.

The Voicepoints were chosen to be used at Maryborough and Nambour because of the number of people involved at each centre, since the only facilities at those places were a Versatel telephone and a cheap loud-speaking telephone, neither of which would enable a group of more than 3-4 to hear anything! Some early teething problems were experienced with the Voicepoints which had nothing to do with the units themselves, but related to how they were set up. One problem was that the unit was set up in an almost infinite space, that is one with walls some 10-15 metres away. Since the Voicepoint cancels echos by generating white noise for ten seconds and measuring the return echo and adjusting itself, and since there were no walls to reflect the sound, the unit did not adjust itself properly. This problem was solved by moving the unit to a smaller room. The other problem resulted from the handset being connected to the line socket and the line cord being connected to the handset socket. Whilst using the handset when originating the call no problem was experienced since the connection is a straight loop through, but as soon as the Voicepoint was put into conference mode and the handset hung up, no conditioning occurred and we were disconnected! As we were troubleshooting from Brisbane by remote control it took a while to realise what was wrong, especially since we could talk to the person using the unit before they pressed the conference button!

The Confertel teleconferencing bridge was used to avoid the excessive Telecom charges of $22.10/leg/half hour. This unit allowed the option of breaking the three centres into groups for specific instruction. In some cases the two larger groups were set tasks to do and they were asked to turn their microphones off whilst the Daintree student was transferred to the second conference line on the bridge. This enabled us to give that student some personal tuition whilst the other groups were working on the assignments they had been given. They were unable to hear us or each other but we could contact them because their loud speakers were not switched off.

At the appropriate time Daintree was put back into the conference and the two groups were recalled and asked to switch on their microphones. The results of their findings were then shared with the whole group and the conference wound up. The discipline problems referred to earlier were also addressed using this technique of subconferencing by pulling that group out in the next conference and addressing them with some more difficult questions which required much more thought. In this latter instance Daintree was asked to participate in the group discussions of the people at Mackay.

Print Material

The print material covered the main teaching points of the videos and included assignments. In hindsight, far more self-test questions could have been included, to provide students with a focus for viewing the satellite broadcasts and also to facilitate the questions and answers which were part of the telephone conferences.

Conclusion

The majority of students expressed delight at being able to continue with their studies. They accepted the teething problems of the pilot project amicably. To date, the continuous assessment projects which form part of the course assessment have been well prepared and are of suitable standard. Students will be undertaking final examinations shortly after the preparation of this paper.

Divergence

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TAFECOM New South Wales

The idea of convergence in educational technology generates an image of concentrating numerous services as if entering a tunnel. In this paper, it will be argued that it is what happens at the other end of the tunnel or the user end, the divergence, that also needs considering.

The paper is in three parts. Part One looks at one aspect of convergence in the development of Integrated Services Digital Network (ISDN) telephone technology. Part Two will present a current case of the use of that technology in New South Wales TAFECOM and the characteristics of that trial. Part Three will look at the future of technology and the need for divergence within convergence.

Short anecdotal history of the telephone as convergent technology

In 1876 Alexander Graham Bell is reported to have said, "Mr Watson come here, I want you"[1]. By the middle 1990s we will, as teachers, trainers and as private citizens be seeing others at the end of a telephone line as if they are in the same room. This used to be the fantasy behind the science fiction of *The Jetsons* and detectives such as *Dick Tracey*. In a recent report of the Sydney Morning Herald the development of the "wrist phone" is in progress.[2] The video phone already exists in R&D Departments of telephone companies around the world. But more importantly video conferencing and related to it video instruction using telephone lines is being tried and used in Europe and Australia.[3]

In the early 1980s the Elliston Project[4] would have been one of the first to use a range of technologies to converge on the telephone line and to re-emerge at the other end with reasonable accuracy. In the last eight years the technology has progressed.

In the mid-80s the Victorian [state of Australia] school system with assistance from agents such as Country Education Project and the Innovations Program, developed electronic messaging systems in the remote

1 Bell A. G. (1989).cited in *Bloomsbury dictionary of quotations* p. 28 London: Bloomsbury Publications.

2 "Ol' Dick Tracy might get us yet" By Peter Hughes Sydney Morning Herald p.3. 9/2/1990

3 *Progress Report on the Light College—Adelaide College Videoconferencing Network Project.* Occasional Paper 15 November 1989 Adelaide: Department of Employment and TAFE South Australia

4 The Elliston Project (1981). *A Trial in Distance Education.* Education Technology Centre. Adelaide: Education Department of South Australia.

Mallee and East Gippsland areas.[5] In late 1989 the University of New England trialled interactive video conferencing between the central campus and a study centre.[6]

In Europe and the UK the use of telephone to support student learning is well reported. The Open University of the UK has for some time been expanding the use of modem links for students enrolled in courses requiring the use of computers.[7] Similar examples exist in countries such as Denmark. In Denmark, the Aarhus Consortium is exploring the use of the telephone lines as an interactive instructional device.[8]

At the moment, most of these examples use a very limited set of sites where instruction can take place. In part this reflects on the 'experimental' nature surrounding these attempts to use the telephone line as means of converging the technologies. But there are further considerations about access to this technology.

In the short term the access to much of this 'new' technology is costly and this can be a barrier to participation for some learners. For both the instructor and the learner to connect and make the telephone lines usable, the information must be translated into digitised data. This requires a computerised digitiser for vision, a modem, appropriate software packages and a printer for any hard copy. The cost of such equipment for the learner could be prohibitive, whilst for the institution, the provision of equipment could cause a drain on available resources.

In the long term the cost of the technology is expected to decline. One unanswerable question, as yet, is will the cost decline to a level where it can be claimed that using technology is not a financial obstruction to participation in courses.

The second factor in the 'limited site' for trialling and evaluation is the need to schedule the presentation of course material. A real consideration in the near future is going to be an answer to the question: How do you handle multiple sites? At the moment the limited sites of trails are determined by the limitations of yesterday's technology. This is disguising the fact that with tomorrow's technology, the reality will be in-home [as distinct to in-house or on-site] delivery of instruction.

But what of today's technology? The next section outlines a trial conducted within TAFECOM New South Wales on the use of ISDN [Integrated Services Digital Network] Micro-link from July to September 1990.

A present case : ISDN Micro-link in TAFECOM New South Wales

At the time of writing this paper, TAFECOM New South Wales is

5 Wilson, J. (1989). *Technology in Distance Education:* Conference Proceedings 9th Biennial Forum ASPESA.

6 UNE/TELECOM (1989). Trial of Interactive Video Using Data Comprehension Techniques Between UNE Armidale and UNE Coffs Harbour 3-13 October,1989. Armidale: University of New England.

7 Castro, A. (1989). *Information Technology at the British Open University*. Institute of Distance Education Deakin University.

8 DEUS Newsletter (1988). (Danish Enterprise University System Training Network) December, page 6.

entering into trials using ISDN Micro-link technology. The trials will look at data transfer, interactive computer conferencing with multi-screen capabilities and the use of visuals in interactive settings. One concern of this trial is not to fall into the 'technology traps' of concentrating on the glamour of the use of ISDN. One hope of the trial is that the technology will prove to be transparent in terms of any effect on course material delivery.

It must be restated that TAFECOM is an education and training environment. Within this environment both instructional correctness and the need for certification of skills and knowledge gained are central. The charter of TAFECOM is to present appropriate course material in a timely and cost effective manner. The need for high resolution images of 'talking heads' may do wonders for the ego of the presenter in high cost technology delivery modes of broadcast television or satellite distribution. However the emphasis on emulating these high cost settings also skews the intent of producing the instruction away from presentation of content. In the TAFECOM context most of the presentation of content is illustrative and demonstrative. These techniques are within the technical capability of the current ISDN 'Micro–link' technology. This makes ISDN one more means of delivery.

In this trial the possibilities and modes of operation will be canvassed. The stages of the trial are to speculate, to attempt and to evaluate the results. The aims of the trial are as follows: [9]

- *To demonstrate the effectiveness of ISDN as an educational and training mechanism when used appropriately.*
- *To quantify the costs of the use of ISDN against alternate modes of delivery of similar courses.*
- *To establish the most appropriate instructional methodologies when using ISDN as part of the course delivery system.*
- *To use the trial to demonstrate the delivery of course material to an enterprise. [In this trial the enterprise will be Telecom Training].*
- *To use the trial to validate the expansion of the use of ISDN throughout TAFECOM as a tool to achieve corporate goals.*

Whilst it is possible to speculate on the uses of ISDN, the first purpose of the trial is to determine parameters of use in an education and training setting. Having determined these parameters trial material based on the guidelines will be produced and tested. This will set the educational and training use of ISDN in context. The key factor will be interactivity.

One use that will not be trialled is the distribution of a lecture. This is a misuse of the technology because it denies the capability of interaction. If one way communication is needed then broadcast television or TVRO [television receive only] satellite services could be used for the distribution of that one way information. It is also arguable that such a distribution service is more economically provided through the use of pre-recorded video tape. But other considerations are often overlooked.

9 Forsyth, I. (1990). *ISDN Trial Management Pl...* AFE NSW.

In the case of one way 'talking head' presentation the humble audio cassette with support print material is a viable alternative. The pre-recorded audiocassette has many instructional advantages. The audiocassette has no requirement for visual attention to be focussed on the unchanging video screen of the talking head. With appropriate audio design, the visual attention can be directed to note taking and referencing to diagrams and still photographs to enrich the aural message. Using these techniques very effective teaching materials are able to be produced and distributed for a reasonable cost.

The TAFECOM trial of ISDN is being developed and designed to avoid the inappropriate use of this technology. The intention is to define the parameters for optimal interaction in a variety of instructional settings. One activity to take place with all trial teachers/instructors will be to select appropriate course content and designing interactive techniques to facilitate learning of the content.

The trial will use content from various Industry Training Divisions within TAFECOM. This will allow for a spread of industry, training and educational settings to be evaluated. One important element in the trial is that TTS [Telecom Training Services] will participate in the trail alongside TAFECOM staff. This has important spin-offs for both organisations.

The future as today

The future of ISDN technology is with us. As a digital system data and audio have been available for some time. It is now possible to compress a video signal to 1% [yes, One Per Cent] of that signals original bandwidth, transmit that smidgin of a signal down the telephone line, and reconstitute it to the full glory of the original at the other end. The ISDN service is available across Australia and within most major centres as this paper is being written.[10]

Because ISDN Micro-link is an n x 64K service it offers advantages for data and voice over the [current 9.6k] data modems and analogue audio. With the development in video digitisers, interactive video is possible. It must be recognised that this is not full bandwidth video. What is showable, however, is real interaction. What must take place to produce effective interactive education and instruction is the recognition of the limits of ISDN as a tunnel of convergence. At the same time the ability of ISDN to be a means of divergent presentation to students and to 'open up' learning is attractive.

However the future is not so simple. The competition for the telecommunication business of the private, business and public sectors is 'hotting up'. AUSSAT, OTC and Telecom are looking at each others networks and market because of the financial return. Therefore the 'owner' of the technology for delivery may change in the future. What must be remembered is that in the next five years most households currently connected to the telephone network will have the option of a fibre optic line or ISDN capability to service their needs. These services could be replicated or deliverable by satellite or subscription cable networks if further deregulation of the

10 McIntosh, D. (1990). Homework. Sydney Morning Herald 15/4/1990 page 131.

telecommunications industry does take place.

The future then is not just one of convergence. The future is one where the range of services available through ISDN technology or the other distributive technologies will be selectively used for education, training or for pursuing the simple pleasures of communicating. In education and training the range of education and learning strategies available through ISDN technology offers a diversity of choice for presenting courseware. ISDN is a technology that is a focus or a convergent technology. However the effective use of ISDN will require decision-making to be sure that appropriate technologies are selected to support the interactive instructional potential. It will require course designers to be divergent in their thinking to optimise the course reception possibilities at the other end of the ISDN tunnel. Whilst this will increase the opportunities to learn, the full benefit will only be achieved when course developers demonstrate the flexibility to utilise the diversity of technologies accessible through ISDN telephone lines.

D-I-Y publishing for the production of distance education courseware: What have we learned?

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The emergence, in the 1980s of low-cost, sophisticated computer-aided publishing systems allowed organisations which were involved in the development and preparation of course texts, training manuals and other instructional materials to manage and monitor the total preparation of print materials within their own environments.

This paper will discuss the impact of these do-it-yourself (D-I-Y) publishing systems on the quality of distance education materials being produced, especially in terms of the typographic formats which have been adopted. The emergence of desktop publishing technologies will be discussed with respect to the hardware and software upon which they have been based, and the current state of the software will be expanded upon. Also some assumptions will be made regarding the future directions of the desktop technologies.

The purpose of this presentation is to stimulate discussion as to how desktop publishing is being managed and also how the future of desktop publishing and its enhanced capabilities will impact upon the production of distance education courseware.

The Emergence of Desktop Publishing

Although the Apple Macintosh is credited with heralding the foundation of desktop publishing, it is really the development of the laser printer in conjunction with page description languages which initially staked a claim on low cost typesetting. Machines with graphic oriented software (Apple Lisa, Xerox Star) had been in development for some time prior to the release of the Apple McFriendly range of personal computers. However the introduction of the laser printer which could emulate the true font capabilities of a traditional typesetter, albeit at a low resolution, brought a whole new meaning to the term *in-house publishing*.

The successful introduction of laser printing encouraged many software developers to begin the development of typesetting/publishing packages which would run not only on the Macintosh, but also on other existing hardware platforms. As a consequence, programs with varying levels of sophistication became available for the IBM personal computer and its growing number of clones, as well as the larger engineering (Unix) workstations. There was, of course, much value in being able to offer the flexibility to publish documents without the expense of further hardware (except a laser printer if high quality output was a requirement).

Desktop Publishing — A Definition

What then was the purpose of this new technology and what value was it to educationalists who typically knew nothing of typesetting and publishing generally? Certainly the ability to electronically originate and integrate text and graphics on screen and to output these in a camera-ready form has offered distance educators much greater instructional flexibility and document control.

It would seem that one of the major priorities of the software developers was to de-mystify the typesetting and publishing process. This was done by providing an elementary user interface using mouse controlled menus for interactivity. As a consequence, the term *user-friendly* became synonymous with desktop publishing systems.

When these publishing systems were developed on a variety of hardware platforms, the term desktop publishing became more specific to the personal computer approach to publishing, whereas *computer-aided publishing* became a more universal term in referring to the range of both traditional and non-traditional publishing technologies available. At this point, computer-aided publishing encompassed three levels of publishing systems:

- those based on personal computers
- those based on engineering workstations
- those based on traditional dedicated typesetters.

Dedicated Publishing

Publishing systems on traditional typesetters were seen to provide all the typographic flexibility which the non-traditional levels of publishing were trying to emulate. However these machines were not only expensive, but also typically comprised dedicated hardware and software packages which ensured that they were beyond the reach of the in-house market in terms of both complexity and cost.

Electronic Publishing

Unix workstations such as the Sun and Apollo with their inherent networking and performance capabilities provided a sturdy platform on which to run a publishing system. As a consequence, the software which was developed for these machines was generally much more sophisticated and required greater hardware performance than was possible on the personal computer. *Electronic publishing*, as this level became known, found a niche in the corporate market where the workstation hardware was already in existence and being used for other purposes such as computer-aided drafting (CAD).

Although the purchase of workstations for the sole purpose of publishing was viewed as somewhat of an "overkill", the initial purchasers have not had to suffer the problem of insufficient memory and speed — all too common with the personal computers of 3-4 years past.

Personal Publishing

Desktop publishing or *personal publishing* at the PC level — including of course the Macintosh — has proven to be the boom area of non-traditional publishing. There are several reasons for this and these will be dealt will further on in this paper. However it was mainly the low cost of both hardware and software which encouraged most people to publish at this level, as well as the number of PCs which already existed and were being used for other applications.

For the newcomers to desktop publishing, the major advantage of this technology was its ease of use especially at the PC level. For the professional publisher, however, systems developed at the PC level in early days of desktop publishing provided very few of the typographic intricacies (for example leading, justification and kerning) which can greatly affect the readability and aesthetic appeal of the published work. During the initial years of desktop publishing, the three levels of systems described above were clearly distinct in terms of their complexity.

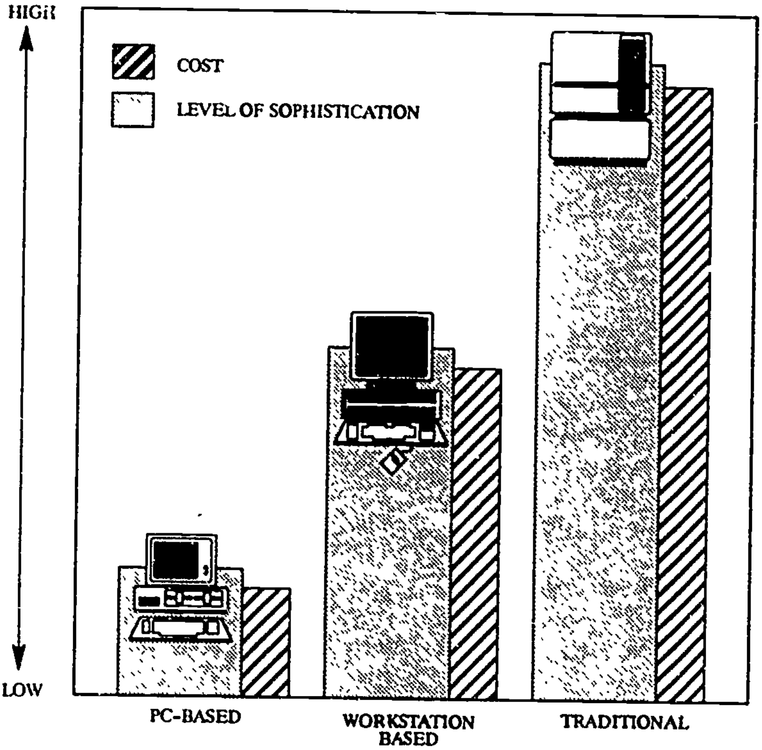

Figure 1: A comparison of costs and sophistication of the three levels of desktop publishing, 1985/86.

Inadequacies of Early Systems

To those institutions who had previously utilised high quality typesetting, desktop publishing offered very little in terms of functionality. Early systems typically suffered from the following inadequacies:

- comparatively low resolution output (300 dpi)
- limited line spacing capabilities
- limited page extent of documents
- no hyphenation or justification capabilities

To exacerbate the problems associated with the initial implementation of desktop publishing in educational institutions, the system suppliers offered little or no training to support their products. Certainly no training programs discussed the principles of typography and layout.

Acceptance by Users

Desktop publishing was viewed with much scepticism by the publishing professionals when it was first launched in this country in the mid 1980s. This was mainly due to the comparative level of software sophistication. However, many distance education providers settled upon this technology as an economically viable means of producing higher quality print materials with greater instructional flexibility.

The upgrading of word processing systems to desktop publishing was perhaps one of the most beneficial applications of this technology in the distance education publishing environment and, as a consequence, typing pools soon evolved into in-house publishing departments.

When desktop publishing was made available to the open market, ease of use was a major consideration in the design of the publishing software. The "What You See Is What You Get" (WYSIWYG) display was a fundamental step towards *user-friendliness* and it was this ability to easily control the elements on the screen which made the systems so attractive to the first-time user.

The Impact of Presentation

Although most of the early desktop publishing systems lacked the typographic functionality demanded by traditional publishers, their introduction into distance education publishing opened up something of a "Pandora's Box" for the many educators who were keen to embrace the new technology. The seemingly inexhaustible range of type fonts and sizes coupled with the ability to combine a wide variety of graphic devices, encouraged the users (and, of course, the writers) to experiment with the students' ability to read and comprehend the resultant materials.

The inference that *anyone* could publish using the desktop systems resulted in a proliferation of printed educational materials which, in many cases, were devoid of the essential typographic characteristics which play a major role in determining not only the aesthetic appeal, but more importantly the readability of the printed piece. This is quite understandable (although not forgivable) if one considers the particular responsibilities (traditionally the domain of the publisher/printer) which have been taken over by these non-traditional publishers.

While newly installed publishing systems offered an enormous degree of typographic flexibility in comparison to the superseded word processor, it soon became apparent that if there was no control over the operator's, and the author's, use of these facilities, there would be, ironically, a degradation in the quality of instructional materials produced. In order to develop a coherent style, both the typographer and the instructional design team required an intimate knowledge of the functionality of the publishing system. A typographic style was seen as essential for a variety of reasons:

- to facilitate the development of study materials by offering writers a variety of instructional features and ideas
- to facilitate the production of study materials through its use as a reference manual detailing the typographic format of all components
- to exploit the full functionality of the publishing software and thereby act as a selling tool for the publisher.

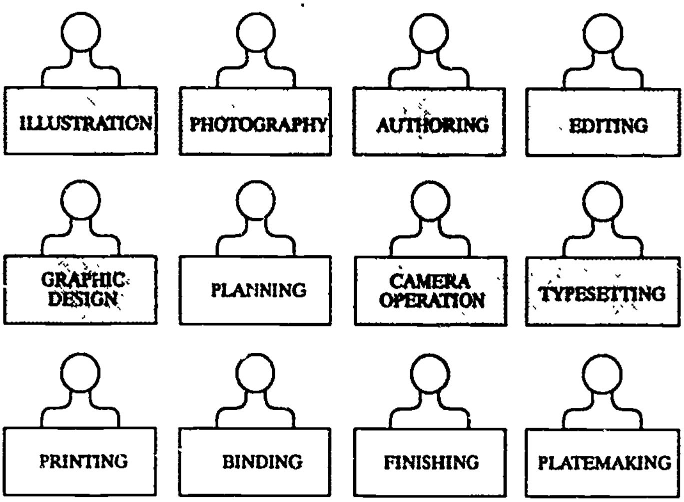

Figure 2: The skills/responsibilities of personnel involved in the publishing process. Highlighted are those which can now be controlled by the desktop publisher.

With the availability of a greater range of typographic features and page formats, authors and instructional designers now had the opportunity for more creative expression and enterprise in the design of instructional materials. Whilst the presentation of material has been contained within the requirement of this institution's *Style Guide*, there has been a noticeable increase in the use of the graphic features of the desktop publishing software. Tables, graphs, charts, illustrations and icons are all being used by authors who are showing greater interest in exploring improved and alternative methods of displaying their instructional texts. The outcome has been that the instructional materials are now far more sophisticated than ever before, however it is still not fully appreciated by authors that the effectiveness of their materials is greatly dependent upon expert instructional and typographic design input.

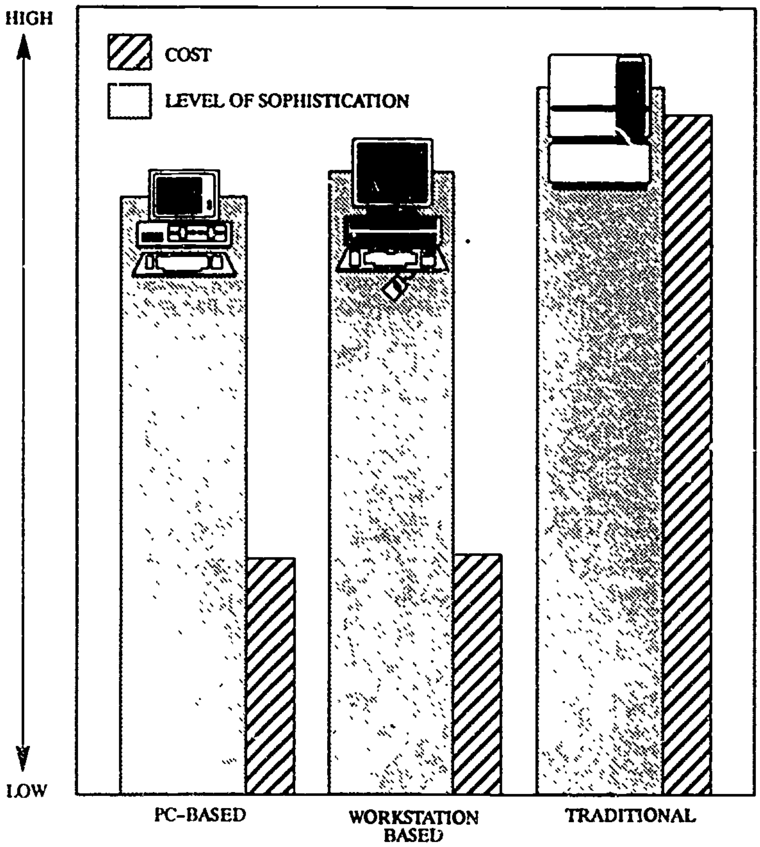

Figure 3: A comparison of costs and sophistication across the three levels of publishing, 1990.

The Development of Desktop Publishing

As the demand for more sophisticated desktop publishing systems grew, so did the number of suppliers of publishing packages. The increasing amount of competition over the past four years has resulted in the development of programs which offer not only greatly increased typographic functionality, but also extremely sophisticated graphic handling capabilities. The limitations of the early desktop systems no longer exist, and further, many of the systems now in existence will compete very admirably with the professional publishing systems.

While only four years ago, publishing professionals were concerned that the desktop systems lacked many of the most fundamental typographic elements, the systems of 1990 offer typographic flexibility comparable to to the most sophisticated traditional publishing systems. Moreover, the desktop systems are significantly less expensive.

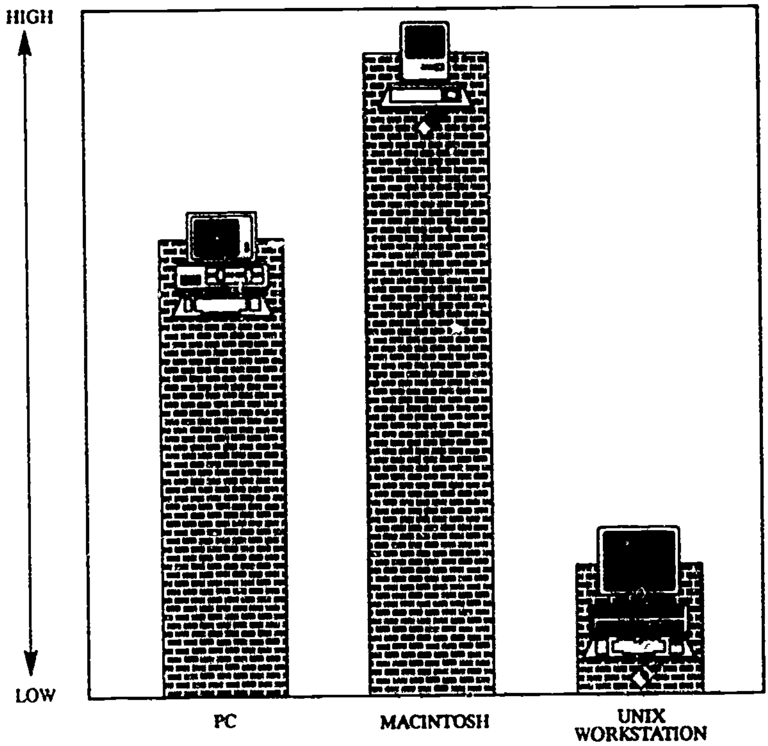

Figure 4: A comparison of desktop publishing software availability across various platforms, 1990.

The development of desktop publishing software has been mainly aimed at the microcomputer level simply because this is the larger user base. Currently there is more publishing related software available for the Macintosh than any other PC although there has been much re-writing of existing packages to run on alternative PC platforms.

The requirement for desktop publishing features have become so significant in software development that the latest versions of basic word processing programs contain pull-down, mouse-controlled menus and graphics manipulation tools as standard features.

Paralleling developments in publishing software, there has been dramatic developments in hardware — especially at the microcomputer level. Whereas four years ago those contemplating professional desktop publishing would not have considered a Macintosh or PC purely on the grounds of computing power, the incorporation of the latest high speed microprocessors from Intel and Motorola ensure that today's microcomputers compete admirably with Unix workstations.

While many may rejoice that these high-end microcomputers are now competing on equal terms with the engineering workstations, there are some noteworthy disadvantages:

- In striving for greater hardware sophistication, the microcomputer suppliers have sacrificed their traditional market advantage of cost. High-end microcomputers are similarly priced to low-end Unix workstations with similar functionality and speed.
- As higher capacity microcomputers are developed, so too are desktop publishing programs which require that high capacity in which to run. These new programs are then, of course, out of the reach of the low-end microcomputer users. This is also happening as publishing programs are revised and updated.

A Requirement for Specialist Staff

It appears that as the desktop technology progresses, the author will gain more control over the initial stages of the production process. For the author, it seems a natural progression in technology to be able to not only supply the words but also dictate the way in which they should be displayed on the printed page. However, it is perhaps presumptuous to assume that the author will possess the appropriate design skills to produce text which conforms to established typographic principles.

These composition skills, which are essential in ensuring the readability and aesthetic appeal of the product, already exist with tradespersons in the printing industry and it is these skills which have become quite a marketable product. While many institutions have enlisted the services of a typographer or graphic designer to aid in the development of a publishing style, others continue to allow the content experts to determine the presentation style of their materials (often at the expense of readability).

The printing and publishing industry still sets the standard regarding the quality of print design and, in trying to emulate that standard, the higher quality end of the desktop publishing industry has made enormous progress in producing exemplary materials. This increase in quality is not necessarily due to greater sophistication of desktop software, but moreover from a realisation that higher quality design, and not simply typesetting, is necessary to compete with the traditional printed industry.

Because desktop publishing offers educators greater instructional flexibility, the requirement for instructional design expertise has also grown. This expansion has also been influenced by a national requirement for higher quality materials from fewer distance education providers.

From a production standpoint there has also been a requirement for publishing system operators with much greater skills than in the past. Although they are typically guided by a publishing style, operators require, in addition to software familiarity, a thorough knowledge of the typographical factors that can affect the readability and subsequent comprehension of instructional texts.

Desktop Publishing — A Viable Solution?

One of the key factors addressed by distance education providers when arguing for the replacement of word processing by desktop publishing was that there would be a significant saving in the production of materials in terms of both time and resources. However, it would appear that while desktop publishing has made a considerable impact in providing the tools to expedite the publishing process, there is a considerable amount of materials now being published using this technology which would not previously have been considered worthy of reproduction given the expense of the traditional production method. In addition, there is much more likelihood of the finished product having greater aesthetic appeal than if prepared on traditional wordprocessors.

Further, desktop publishing has resulted in a heightened demand for "in-house" documentation to be be of higher quality. In many educational institutions, 200-300 dpi laser output for the likes of memos, reports and general correspondence is now viewed as minimum acceptable quality.

Creating Expectations

As the demand for quality publishing increases, so do the expectations of all involved in the publishing process:

- Publishing operators expect manuscript copy to be supplied on disk or at the very minimum presented in double line spaced typescript — these being accepted standards of professional publishing houses.
- Authors expect their documents to be totally error free and have generally become more meticulous in locating minor inconsistencies which would have been overlooked in previous typewritten versions of their materials.
- With the vast increase in the typographic quality of camera-ready copy delivered to printers, there is an expectation that this quality increase will be emulated at the backend of the production process.

In addition, students may also have some expectations about the quality of printed courseware when studying between different institutions. Moreover the fact that there is a connection between studying performance and the quality of courseware (Cookson 1989) should prompt all distance education providers to carefully review the instructional and typographic quality of their materials.

Desktop Publishing — The Future

Since its introduction in the mid 1980s, desktop publishing has made a significant impact upon the production of educational materials by demystifying the intricacies of the publishing process. Its cost, user-friendliness and capabilities provide a natural progression for the distance education provider into a more professional approach to the preparation of instructional materials.

Since its introduction, desktop publishing has evolved from glorified word processing to high quality, professional publishing. The limitations of early systems have been overcome and the sophistication of current software compares admirably with the complex typesetting and pre-press systems available for the traditional graphic arts industry.

A significant recent development in desktop publishing is the availability of colour separation software enabling both spot and full colours of a document to be output as separate printing masters. Colour printing has traditionally been too expensive to contemplate for the bulk of distance education materials, but the ability to supply colour separated camera-ready artwork to a printer will significantly reduce these costs.

In the future, the ability of high speed photocopiers to print in several colours may make colour printing the rule rather than the exception. This capability will also have a profound effect upon the instructional quality of materials by offering designers a further tool to aid in the presentation of information.

One of the objectives in the development of desktop publishing was to create the paperless production area. In many ways this has been achieved through the electronic integration of text and graphics obviating the need for manual paste-up. The output of these current systems is as camera-ready art or, in some cases, direct imaging to plate. While this has expedited the preparation of text and graphics, there has been little development in technology to automate the platemaking and printing processes.

With the major developments in both desktop publishing and copying technology and the similarity of the latter to laser printing technology, the next logical step would seem to be the provision of a total automated publishing and printing network. This may involve the development of large raster image processors (RIPs) with spooling capabilities to drive one, or a number of, high quality printers/copiers using laser or ink-jet technologies.

In essence, this type of system would be driven by the front end with the RIP acting as a multiplexing device which distributes the workload amongst a variety of high speed printing devices. The use of the laser or ink-jet printing processes would obviate the need for the printing plate — another reproduction process. These high speed printers would then be on line to collators, binding machines and trimmers requiring minimal manual intervention. This type of system would be most productive in an environment which catered for demand printing where there is no necessity for warehousing of materials.

It would not be presumptuous to also assume that desktop publishing systems will begin to utilise artificial intelligence. These resultant expert systems may develop the capability to advise the author on preferable means of text layout for the production of effective layouts in terms of aesthetics and readability.

There can be no doubt that in the last five years there has been a technological revolution in educational publishing. Perhaps what we have witnessed is a mere glimpse of the technological advances we can expect in publishing in the next five years.

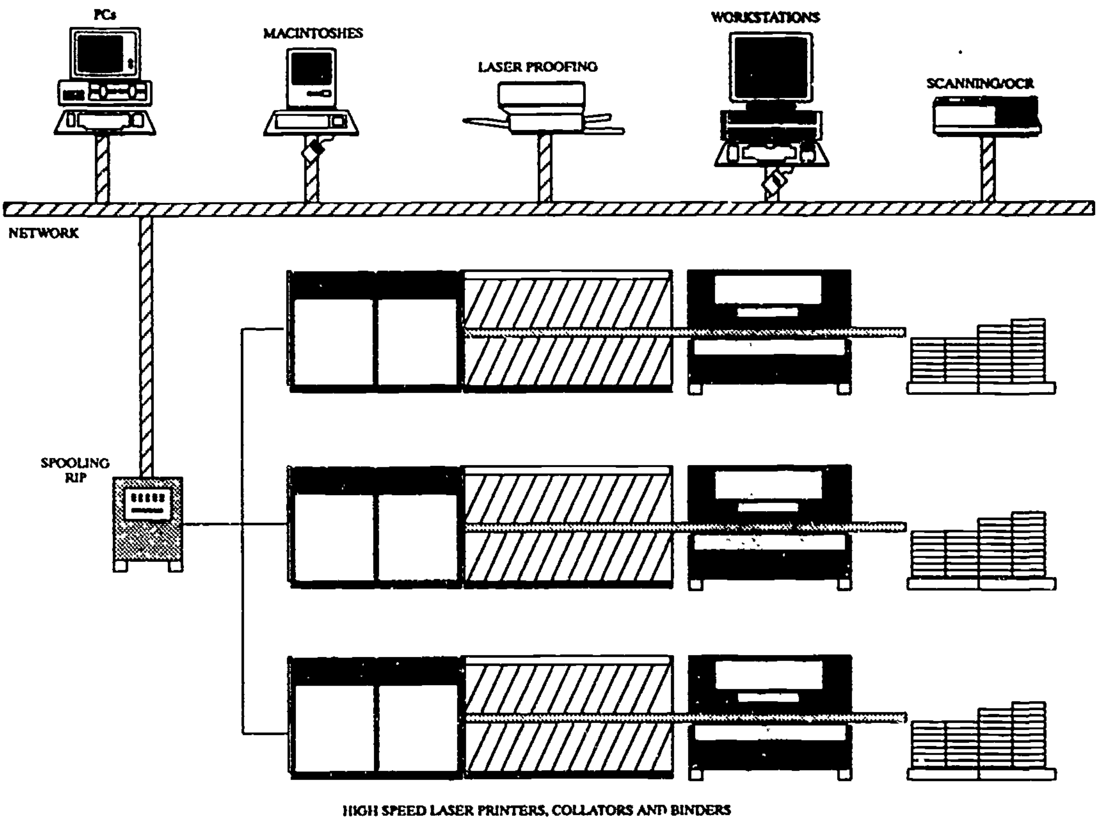

Figure 5: A futuristic view of desktop publishing integrating the printing and finishing processes.

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Keyboarding, touch typing and computers: What students think

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This paper presents the findings of a survey questionnaire conducted in September 1989, regarding the role and value of computer keyboarding and touch typing skills for New Zealand secondary school students. Data were collected covering the following area: socio-economic status of parents; gender; time spent using the typing tutor; educational and vocational goals; perceived keyboard competence; preferred keyboard teaching methods; and, the value of typing courses. Results indicate that significant numbers of students want to learn keyboarding and touch typing ($p < 0.01$). Specifically, they want structure, guidance and instruction provided by specialist typing teachers working in conjunction with their normal classroom teachers and would be prepared to undertake these lessons in their own time. Discussion covers implications for administrators and teachers responsible for the design of education with computers in schools.

Many researchers have commented upon the increasing use of computers across the curriculum and the consequent demands being placed on students to use the keyboard effectively (see for example, Jackson and Berg, 1986; Hoot, 1986; Wharton S, 1988). There appear to be, however, two opposing views as to how children should learn to use the keyboard. The constructivist view emphasises the need for free exploration and discovery, favours allowing children to use the keyboard as they see fit, and seeks to focus children's attention on the cognitive processes. The opposing instructionalist view, normally espoused by typing teachers, regards this process as wasteful and likely to induce frustration in the pupils as they "hunt and peck". Moreover, they fear that children will learn bad habits which will be difficult to extinguish when they come to learn touch typing (Hunter *et al*, 1988). Throughout this debate very little empirical data has been collected concerning students' attitudes towards keyboarding skills (Gerlach, 1987, cited in Hunter, 1988).

Effective use of the keyboard involves two factors both of which might be included in a definition of computer literacy. These two factors have been identified as touch typing and keyboarding (Henderson-Lancett, 1985; Wharton, 1988). Keyboarding refers to the correct manipulation of the keys on the keyboard (Jackson & Berg, 1986) and includes the use of specialist keys such as function keys, "Control", "Alt", and combinations of these. This definition may be extended to include the use of peripheral input devices, for example the mouse. The acquisition of keyboarding skills is primarily linked to the use of particular software packages and may be taught in the context of their use. Touch typing is a subset of keyboarding and is defined in the same sense that is understood in the use of typewriters, that is typing accurately while not looking at the keyboard. Touch typing is usually established through routine practice.

While teachers and research staff involved in the Freyberg Integrated Studies Project realise that both factors are important, such considerations as time constraints and lack of personal expertise have meant that very little attention has been given to the development of touch typing skills. The need to encourage the development of these skills has been acknowledged and an interactive typing tutor installed on both an IBM JX network with 32 computers and 15 stand-alone PS/2s. The formal teaching of typing skills has, however, progressed in an ad hoc manner. Some teachers have scheduled class times for the development of touch typing skills while others have conducted an initial session and subsequently left pupils to develop their own skills. The researchers have observed a wide variation of typing speeds and keyboarding skills amongst pupils. It was decided, therefore, to assess the pupils' attitudes towards: keyboarding and in particular typing skills; preferred teaching methods; the use of a typing tutor; and, the relevance of keyboarding skills to their educational and job aspirations.

This paper presents the findings of a survey conducted in September 1989 by the Freyberg Integrated Studies Project research staff regarding the role and value of computer keyboarding skills for secondary school students.

Method

Subjects and Setting

The school in which this study was conducted is a typical New Zealand co-educational secondary school drawing pupils from both country and urban areas. Students elect to participate in the Integrated Studies Programme on entry to Form 3 (year 8), the first year of high school. Integrated Studies involves the students using the computer for a minimum of three hours per week. Word processing is the most commonly used software package and is used by all classes for approximately 75% of the time they are using computers. A questionnaire was administered to 240 students in nine classes in forms three and four. All students involved in the Project who regularly use the computers were surveyed. Additional classes in both forms not involved with the Project acted as comparison groups. Top classes in both the Normal and Integrated Studies programs are streamed on ability in Mathematics and English. The remainder of the classes are parallel. The Integrated Studies classes surveyed included the top third and fourth form classes, two parallel classes in each of the third and fourth form. The 'normal' classes surveyed included the top third and fourth form classes, and a parallel fourth form class.

The questionnaire comprised 49 questions seeking information on

Class	1	2	3	4*	5	6	7	8*	9*	Total	%
female	16	8	12	13	17	9	7	16	14	112	46.9
male	14	20	17	13	14	17	14	6	12	127	53.1
Total	30	28	29	26	31	26	21	22	26	239	
%	12.6	11.7	12.1	10.9	13.0	10.9	8.8	9.2	10.9	100.0	100.0

(Chi-Square=15.04, D.F.=8, p=0.0584, 1 missing observation)

TABLE 1: Gender composition of the classes — (*) normal program

eleven pertinent factors: socioeconomic background of parents; gender; time using computers; applications used; subject preferences; application preferences; educational and vocational goals; perceived keyboard competency; preferred teaching methods; and, the value of typing courses. The questionnaire was administered by a Project researcher during normal class time.

Results

In the sample there were 112 females and 127 males, and one individual who did not report his or her gender. Table 1 below shows the there was no significant difference in the gender composition of the classes surveyed.

The Elly-Irving Socioeconomic Status Scale was used to determine the SES of both parents. A cross tabulation of both parents' SES against the presence of a computer at home revealed no significant differences across groups, that is SES of mother or father makes no difference as to whether students have a computer at home. Table 3 shows the results for father's SES against the presence of a computer at home. It may be noted however, that significantly more boys than girls have a computer at home (Chi-square = 5.26, D.F. = 1, p = 0.022).

A clear majority of students (79%) thought that the minimum level of touch typing skill they should master was "working from the home keys, but looking at the keyboard". One-way ANOVAs of class by skill level and form level by Integrated Studies group membership by skill level revealed no significant differences across groups. That is, students had similar expectations with respect to the minimum level of skill they should have when using computers.

SES->	1	2	3	4	5	6	Row Total
yes	13	15	21	32	9	6	96
no	10	8	17	45	21	3	104
Total	23	23	38	77	30	9	200
%	11.5	11.5	19.0	38.5	15.0	4.5	100.0

(Chi-Square = 10.634, D.F.= 5, p = 0.059)

TABLE 2: Fathers' Socioeconomic Status against Presence of a Computer at Home

While, as indicated above, 78% of students thought that "working from the home keys, but looking at the keyboard" was the minimum skill level they should master, 65% indicated that they actually operated at this level or better. Further analyses of these data indicated that the level of keyboard mastery reported by the students was not dependent on either form level or group membership.

In response to the question "has your class had any formal lessons on how to type using the computer keyboard?", 42% of students indicated that they had received at least 1-3 lessons. A one-way ANOVA with multiple comparisons (Student-Newman-Keuls at 0.05 level) revealed that the Integrated Studies classes and the third form 'normal class' had received a significantly greater number of lessons than the fourth form comparison classes ($F=3.79$, $p=0.015$).

When asked about the desirability of having "computer keyboard skills instruction for students who use computers at school", only 4.6% of students disagreed with the statement. When asked whether regular computer users should be 'required' to have a touch typing speed of 20-30 wpm, 40.2% of students disagreed while only 18% agreed. If the school was to provide instruction over a six to ten week period, however, objections dropped to 11.3% with 80.4% of the students indicating that they would be motivated to master this level of skill. One-way ANOVAs revealed no significant differences for the first two questions. Differences were revealed, however, for the third question with both the third and fourth form Integrated Studies classes being significantly more motivated to master a touch typing speed of 20-30 words per minute than either the third or fourth from comparison groups ($F=6.97$, $p=0.0002$).

Students were asked three questions relating to their preferred method of typing skills instruction during normal school time. These were: using a computer and a typing tutor program; conventional typing exercises on a computer, and; conventional typing classes using a typewriter. Figure 1 below shows that students have a preference for the method of instruction: 55% opted for the first mode, 38% opted for the second and 29% opted for the third. Students appear to prefer instructional methods which employ a computer. There is less preference for methods which have elements of conventional typing instruction. This was emphasised by the fact that 78% of the students responded negatively to a later item which stated that students who use computers for regular class work should be required to take typing lessons as a subject option.

A series of one-way ANOVAs was carried out on each of the questions related to preferred instructional mode using class groupings as the independent variable. The Student-Newman-Keuls multiple comparisons test was used to look for significant differences between the classes. These showed that the third form Integrated Studies classes had a significantly greater preference for using a computer and typing tutor than did the fourth form 'normal' classes ($F=2.74$, $p < 0.05$), while the third and fourth form 'normal' classes had a significantly greater preference for conventional typing classes ($F=2.92$, $p < 0.05$).

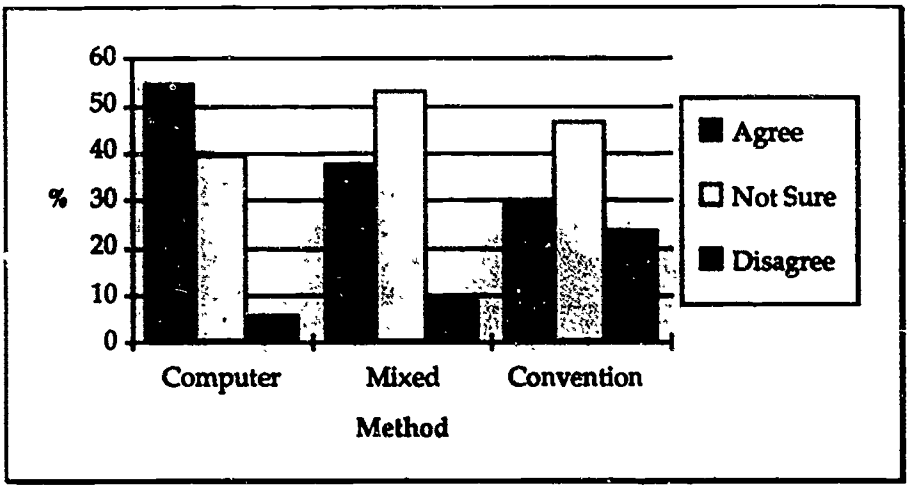

FIGURE 1: Graph of Frequency Against Preferred Formal Method of Keyboard Instruction

When asked who should provide the instruction on typing skills, 31% of the students thought that it should be a specialist typing teacher, with only 8% stating that it should be a normal subject teacher. The remaining 61% wanted both types of teachers to be involved. A one-way ANOVA, with multiple comparisons, of class by provider of instruction, showed that there was no difference in the preferences of the classes for the provider of keyboard instruction.

The typing tutor program used in the school is an IBM version of a commonly used commercially available program. The tutor uses a standard approach to teach touch typing. Finger location sessions are rapidly followed by skill building sessions using real words. Rapid feedback is given in the form of graphs and other data showing student learning trends. Touch typing tests, as far as possible, use words and sentences which make sense. A typing game is also provided using words at an appropriate level of difficulty.

A further four questions sought information on: participation in traditional typing classes; typing speed using the typing tutor; frequency of typing tutor use, and; length of typing tutor sessions. A series of cross tabulations and one way ANOVAs was carried out using gender and participation in traditional typing classes as factors. The results of these analyses demonstrate that females in all classes have significantly higher keyboarding skills than males and practice these skills more frequently and for longer periods using the typing tutor.

Participation in a typing class was highly correlated with gender (Chi-square = 75.00, DF= 1, p = 0) with four times as many girls than boys reported as having taken typing classes. Females did not use the typing tutor significantly more frequently than males, but they spent significantly more time on each typing tutor session (F =10.81, p=0.0012). On average, females spent 15-20 minutes per session, while males only spent 5-10 minutes. In addition, students who had participated in a traditional typing class spent significantly more time using the typing tutor ($F= 12.72$, $p = 0.0005$); 15-20 minutes as against 5-10 minutes. As would be expected from these data, females have significantly higher typing speeds as measured by both the typing tutor ($F=12.09$, $p=0.0006$) and traditional methods ($F= 16.56$, $p = 0.0001$).

	mean words per minute	
	typing tutor	traditional method
females	35	30
males	18	12
N	N=166	N=161

TABLE 3: Student Typing Speed by gender

Students were then asked about when the instruction should occur.. The following alternatives were given: using a typing tutor in their own time (lunch, before and after school); being permitted access for supervised practice in their own time, or; practising during class when other work was finished. Figure 2 shows that 45% of students disagree with having to use a typing tutor in their own time. This figure drops to only 10% if the school was to offer supervised keyboard skills practice during lunchtimes, before or after school. Moreover, 75% of the students are in favour of practising typing skills during class time if all of their other work is finished.

While there is an apparent significant difference between classes where using a typing tutor in their own time is concerned ($F=2.774$, $p < 0.01$), there is no significant difference when compared pair-wise using the Student-Newman-Keuls test. Of the third form comparison group, however, 70% disagree with having to use the typing tutor in their own time compared with 45% of the third form Integrated Studies students.

Table 4 shows that once the basic skills have been mastered, 49% of students agree that there is need for ongoing computer keyboard skills instruction, and that 57.1% of the students agree that they would assume responsibility for maintaining and improving those skills. A one-way ANOVA of group by need for ongoing keyboard skills instruction, with multiple comparisons, showed that the third form Integrated Studies classes agreed with the statement significantly more frequently than did the fourth form Integrated Studies classes. There were no significant differences between classes where personal responsibility for maintaining and improving skills is involved.

Students were asked three questions on their educational and occupational aspirations. These data are not presented here. They are the subject of another paper. It may be noted however that female students had significantly higher educational and job aspirations than did the males. A further two questions were asked that related to whether or not knowledge of computer applications and mastery of computer keyboard skills would help them in achieving their educational and vocational goals. There was no significant gender difference with regard to a knowledge of computer applications helping students achieve their educational goals or in helping them get a suitable job. In both cases 80% and 84%, respectively, of students believed that computers would help.

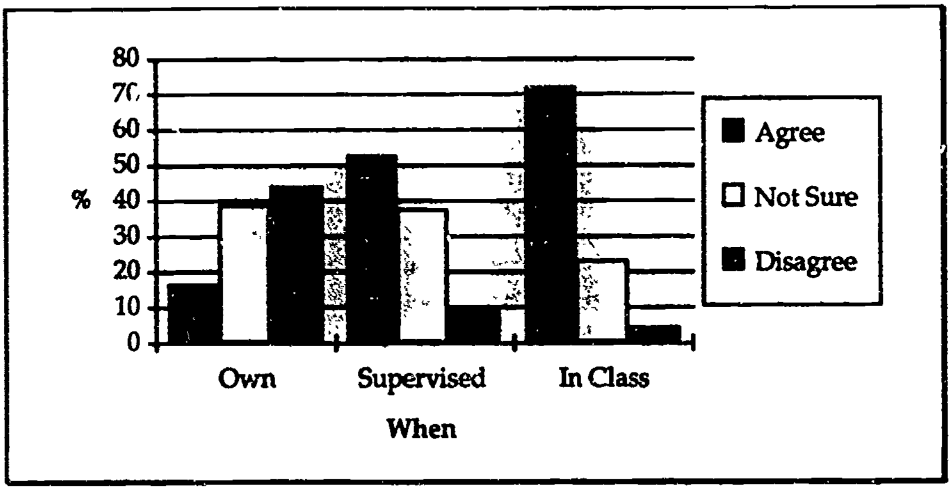

FIGURE 2: When Instruction Should Occur

	Agree	Not Sure	Disagree
Need for ongoing keyboard skills instruction	49%	40.3%	10.7%
Personal responsibility for maintaining and improving skills	57.1%	33.5%	9.4%

TABLE 4: Ongoing Keyboard Skills Instruction/Responsibility

While 80% of students agree or strongly agree that a competent mastery of keyboard skills would be useful to them when using the computer to do school work, a one-way ANOVA with multiple comparisons, revealed that both the third and fourth form Integrated Studies classes placed a significantly higher value on these skills than did the comparison groups ($F=13.93, p=0$). A similar result was obtained when the students were asked if keyboard skills would be helpful in getting them a job. A one-way ANOVA with multiple comparisons revealed that the Integrated Studies classes placed a significantly higher value on keyboard skills ($F=5.77$, $p=0.0008$) than did the comparison groups.

There was a high correlation (0.69) between students' belief that a knowledge of computer applications would help them educationally and their belief that a competent mastery of keyboard skills would help them gain a job.

Conclusion and Implications

The survey results reported in this paper convey an important message from computer using secondary school students to the teachers and school administrators who design their educational programs. Students who regularly use the computer for their education at school want and need to learn keyboarding and touch typing skills. As other secondary students gain access to computers it can be expected that they too will want to learn keyboarding skills.

The survey revealed that pupils were predominantly using the "hunt and peck" method. They were dissatisfied with this and wished to operate at a higher level. Students saw the teaching of keyboarding skills as a task the school should address. When basic skills are in place, then students acknowledged they should be personally responsible for the maintenance and improvement of skills. Students prefer to have keyboarding instruction in class time but they are willing to undertake supervised instruction during lunch time and before and after school.

There are clear differences between male and female students. At the time of the survey, there was a four to one ratio of females to males enroled in typing classes at school. Females were using the typing tutor more frequently and for longer periods than males, and they had acquired significantly higher typing speeds as measured both conventionally and by the Typing Tutor program.

Since conducting the survey, typing teachers have informed the researchers that more males have opted to attend the traditional typing classes than in previous years. The apparent increased male interest in acquiring typing skills may be linked to their changing perceptions of the usefulness and applicability of these skills in helping them achieve educational and career success especially where they can observe females touch typing at a significantly faster rate.

Both male and female students believe that keyboard competency and knowledge of computer applications will help in furthering their education and in obtaining a job of their choice. While in the past typing has been perceived as a predominantly female domain, the advent of computers is impressing upon males the necessity for competent typing skills.

Generally speaking, the students preferred instructional methods which involved using the computer. They do not want or need to learn typing in the conventional sense. These findings are consistent with earlier studies (Warwood *et al.*, 1985) which indicated that students preferred to learn touch typing skills on computers rather than use typewriters. The contention (Warwood, *op.cit.*) that this preference results from the environment created by the computer (immediate feedback, the ability to make mistakes without teacher criticism, and student control over the pace of learning) appears to be supported by the survey findings.

A majority of students expressed a preference for class lessons where touch typing skills are taught using the typing tutor program in conjunction with sequenced instruction provided by a typing teacher. This student preference stands in contrast with the constructivist view, which emphasises the need for free exploration and discovery of the keyboard during the writing process. The majority want structure, guidance and instruction in school time provided by teachers professionally trained in this area.

These students perceive that keyboard instruction provided at school serves both educational and vocational ends. In the work place, although computers are commonly used, it is problematic whether computer knowledge and keyboarding skills will enhance students' prospects of gaining a job. The majority of students seem to be convinced, however, that this is the case. It is also problematic whether such knowledge and skills, on their own, will improve the likelihood of educational success. It is our claim however, that when properly used in an effective educational context, they will.

The primary aim of Integrated Studies is to demonstrate ways of enhancing the educational effectiveness of schools. The project is showing that value lies in the application of computers to the educational process. Early mastery of the keyboard will help make the computer as transparent as pencil and paper in achieving educational goals, thus helping students and teachers realise the real power of the computer as an educational tool.

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Starting Think-Keying

Uni Carnegie
South Australian College of Advanced Education

Can you write as fast as you think?

Many people are not as productive as they could be because they are using old technology such as pencil and paper, or they are using new technology inefficiently by 'hunting and pecking'.

This paper describes the evolution of a program to enable people to become proficient in basic typing as quickly as possible and with the minimum of pain.

Communicating words via an electronic keyboard is an everyday fact of life. For convenience people often refer to what they are doing as 'typing', even though they are not using a typewriter. The basic keyboarding skills are the same whether one is using a manual typewriter or a computer.

Because the skill of typing has traditionally been denigrated, the majority of people learning to use computers in Australia have resisted learning touch typing. One can make the analogy that car drivers do not look to see where the brake pedal or gears are - if they did, the results could be quite spectacular.

We teach people of all ages to acquire skills and encourage them to practise in order to hone those skills, be they playing a musical instrument or playing a sport - and yet many teachers think there is no need to teach their students to touch type and think-key.

We all know that habits are easier to learn than alter, so why do we allow our young people to become functional cripples, disabled by virtue of an inability to key in fluently?

The answer is not a simple one. In part it is due to the lack of understanding of the complex psychomotor skill of typing. It must also be said that the teaching strategies have left students bored and frustrated.

In the past, typing has been seen as a means of copying text - from typewritten, handwritten or dictated originals, or from shorthand. Increasingly, typing is being done by people who are creating original text: they are think-keying. Fluent typing becomes immeasurably more important in this context, because thoughts, especially pearls of wisdom, have a tendency to disappear if they are impeded in their expression. We must key them in as quickly as possible, or they will be lost, perhaps for ever. We haven't got time to hunt and peck. Our fingers must react to our thoughts and spell them out in the same way as the words dribble off the end of our pen: fluently.

THINK ------------------> KEY

THINK -----> HUNT
&
PECK ----------> KEY

It has been asserted (Austin & Pargman, 1981) that the most fluent performance is achieved by the person who is able to leave the execution of the skill to the unconscious self. The conscious self attends solely to the higher order activities associated with the skill being performed.

Following study leave in the United States some years ago, the author devised a keyboard teaching method using a roller chalkboard to encourage touch typing from the beginning. Students worked with sentences on the board instead of from a textbook at keyboard level. They were paced, because it is important they learn the elements of a skill at production speed and gain the kinaesthetic feedback which enables them to perform fluently. Students were reminded of the time when they learnt to ride a bicycle: if they went slowly they wobbled and fell off. A series of sentences were written on the board and the teacher turned them over the top after students had had time to key in each one. Students responded positively to this system which enabled the faster ones to more ahead while nudging along the slower ones.

As educational technology developed, so did the program.

For several years, slides on the overhead projector replaced the roller board and conference members can see a video of a group of young children learning to type on electric typewriters during their school holidays. They gained a knowledge of the whole keyboard during five one- hour sessions. It was a real thrill to see these youngsters literally running into the classroom to practise their new skill. Now at university, they report the benefits of being able to key in fluently. Thinkkeying was part of their introduction to the keyboard and they enjoyed swapping jokes they had written using only the letters they had learnt.

The introduction of electronic keyboards meant that the need for physical hand strength was removed and so word processing became a tool in the formation of language skills in primary schools.

The next stage of the program's development resulted from a perceived need for business people to be able to acquire a keyboarding skill quickly and perhaps even secretly (because of its un-macho image). Computers were becoming something of a management toy, but they were also being used seriously in firms with dispersed offices, such as Elders Pastoral. The production of Key in for Information, a pack of cards in a plastic wallet, coincided with more than 400 Elders Pastoral branches throughout Australia and New Zealand being linked by electronic mail. Allan Baird, their manager of office systems, was insistent that their staff should acquire efficient keyboarding skills so that they could use the electronic mail for all their interoffice communications and other work, such as preparation of wills for clients. Elders Pastoral prepared a house style training manual which accompanied *Key in for Information* into all their offices.

One reason for the choice of name for the keyboarding package was the excitement generated by on-line databases. So much information available at the end of a computer linkup! High on-line and connect-time costs mean there are considerable financial advantages to be gained from quick and accurate keyboarding.

The success of *Key in for Information* resulted in Pitman, one of the leading publishers in commercial education, suggesting some modifications which would result in an introductory keyboarding textbook. They did not have the means to market a pack of cards. Because of the changed concept, it was with some reluctance that The Pitman 10- hour Typing Program was written.

At about the same time, my colleague, Dr Michael Gerrard, was wanting his students in *Introduction to Computing* to become competent in word processing.

The stimulus for the students learning to type now became characters on the computer screen. In 1987 it was the first software encountered by 270 business students. During their first 75-minute workshop they covered, on average, six or seven units of the program. The first unit introduces the guide keys and subsequent units introduce one or two characters at a time. In their first workshop students are shown by the tutor how to start the program, select lessons, and quit from the program. They are also given guidance regarding the height adjustment of their chairs, their posture, and the arrangement of their work materials. As reported by David McKinnon, who will present his findings at the conference, we found students wanted to be set on the right track by a friendly human being and not just a user-friendly computer.

The KEY program is now used throughout the South Australian College of Advanced Education and in a number of other educational institutions throughout Australia.

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Developing a HyperCard training package: Legal Systems

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INFO-ONE International is a company involved in electronic publishing. Prior to 1988 the company was called CLIRS (Computerised Legal Information Retrieval Systems), and provided on-line legal databases. INFO-ONE still maintains a number of databases (the majority being of a legal nature) but has diversified into other on-line services as well as other forms of electronic publication, particularly optical storage.

The on-line databases are divided into pacs. There is Lawpac (legal), Landpac (NSW Land Titles and conveyancing), Busipac (business and tax), Finpac (financial), Geopac (mineral resources), Mediapac (directory of performers and shot library) and Worldpac (providing gateways to several international databases). The majority of clients subscribe to Lawpac.

The training program that formed the basis of this present work relates to the Lawpac Introductory course which is regularly presented on a face to face basis. The training program receives excellent feedback from its participants, both in the short term and in the longer term. Questions asked through the Help Desk and other data gained less officially indicated to the trainer that users of the system, especially if they were irregular users, needed some way of refreshing the content of the introductory training course.

Lawpac uses the STATUS software, produced in the UK specifically for database applications. Some Lawpac databases are available as CD-ROM products. CD-ROM technology is an efficient and cost-effective method of information retrieval, but it is still a new technology, and until it becomes widespread the on-line system will continue to be used extensively. Even for people using CD-ROM technology, it is necessary to be familiar with on-line systems because unreported judgments are not available on CD-ROM and they are updated regularly on the system. There are also many secondary databases which are updated regularly that are only available on-line. Thus, the on-line system is complementary to CD-ROM technology.

There is a wide range of users of Lawpac. Large law firms have their own legal librarians who search on behalf of the partners, solicitors in government departments either have librarians to conduct their research, or they do it themselves, there are many barristers who conduct their own research and of course there are smaller legal practices where the end user of the information actually carries out the search.

In order to assist clients to use the on-line services effectively and efficiently, several training courses are offered. The most popular is the Introductory Course which deals with the basic STATUS commands and techniques needed to search the databases. Courses are offered in all capital cities and most users are able to attend one of these. However there is a problem with users who live outside the metropolitan area who find it difficult to attend. Barristers in the CBD also have trouble attending courses at set times because of the nature of their work, when they can often have to attend court at short notice. Special after hours training in their chambers can be arranged, but it may be to their advantage to have access to disk based training. Because of this, it was decided to produce a computer based training package which could be sold to country users, to subscribers who wish training in this form and as an optional back-up for clients who attended courses.

Many of the users of these particular legal databases have Macintosh computers in their offices. The widespread availability and simplicity of use of HyperCard software, together with this computer access, provided a good combination on which to base a training package.

Computer based training: An introduction

According to Dean and Whitlock (1989) computer based training (CBT) is a generic term that covers both computer assisted training (CAT) and computer managed learning (CML). Computer assisted learning involves using the computer as an interactive training medium through tutorials, simulations and drill and practice. Computer managed learning involves using the computer to dir the learner through a course which may or may not be computer based. In CML the path the learner takes is dependent on the results and measures of performance taken during the course.

CBT must take into account three fundamentals of effective learning. Firstly, the learners must be active, so there should be frequent questions and problems testing understandings at successive stages of learning. Secondly, the learners should be able to check the correctness and relevance of their responses to questions and solutions to problems. Thirdly, the scheme of learning should be arranged so that solutions to questions, calculations, discriminations and other problem solving activities, tend towards correctness or mastery (Dean and Whitlock, 1989).

CBT offers advantages over training in print form in three areas:

1 The process by which the learner is routed through the lesson is flexible. Branching is an integral part of CBT, something which is not feasible with printed matter.

2 The use of CML allows the computer to serve a wide range of purposes in course management.

3 The training designer can vary teaching strategy and integrate different methods with the use of a computer.

Study on the effectiveness of CBT with legal databases

It has been shown that lawyers spend 20-30% of their time searching for information. Automating information storage and retrieval through the use of computers is seen as a means to reduce time-on-task and increase the quality of the search result. Van Beek, Been and Hurts (1989) carried out an experiment which tested the effectiveness of computer-based training for use in an automated system for retrieving legal information. They contrasted computer-based with traditional (textbook) instruction, computer-based with traditional (paper-and-pencil) practice tasks and easy versus difficult problems.

Since 1983, students at the University of Groningen, the Netherlands, were offered a course on legal information systems. In this course students were introduced to the command language of a frequently used legal database (Kluwer Datalex). This database contains the full text of twenty three Law journals. Search assignments were completed manually, after which students could try out their searches on-line. Search costs, however, restricted these sessions to fifteen minutes per student. In addition, the database was not always 'up'. These factors resulted in students frequently being unable to complete their searches in the allotted time nor did they have the chance to learn from their mistakes.

A computer-based instruction and practice program was developed by the Law School faculty to provide the students with a low-cost alternative for the on-line database. In this program, students were allowed to obtain hands-on experience with on-line information. In preparation for this program, students learned to search for information in the library and then given five legal cases to solve by searching for relevant information in the library.

After some general information about computers, students entered the instructional phase of the computer-based program. This phase lasted two hours and introduced the students to the command language, search strategies and general aspects of database search. In the practice phase, also lasting two hours, students were given the same five cases to solve by means of an emulated database. It was implemented on a microcomputer and was accessible through a program emulating the interface of the real database.

Earlier studies had shown that computer-based tutorials have been demonstrated to be more effective than their traditional counterparts: more was learnt in less time. Van Beek *et al.* (1989) assumed that the quality of on-line searching could be measured by two sets of indicators: command language mastery level and search performance. Command language mastery referred to the proficiency of using the command language (irrespective of the results). Search performance referred to the amount of total relevant information that was retrieved (recall), the amount of total retrieved information that was relevant (precision) and the time-on-task.

The tutorial part of the computer-based program was intended as a replacement for the former introduction to on-line searching which consisted of some lectures and students reading the database manual. The emulation part of the program replaced the manual search assignments and the fifteen minute practice session.

Van Beek *et al.* (1989) formed three hypotheses:

1 Training with the computer-based tutorial would bring about a superior command language mastery level and a higher search performance level.

2 Training with the emulation would be better in terms of search performance and command language mastery level than training without the emulation.

3 Interaction of instruction and practice will allow declarative and procedural knowledge to be developed.

According to Anderson (1983) cognitive skills are acquired in a two-stage process, the first being the declarative stage and the second being the procedural stage. Instructions play a major role in the declarative stage and practice becomes important in the procedural stage. Anderson argued that without the declarative stage there is no proceduralisation.

The researchers found subjects receiving computer-based instruction out-performed their traditionally instructed peers in terms of recall (relating to the fraction of relevant documents that were found) and in terms of efficiency and speed of using the command language. However, no difference was apparent between these two groups regarding precision (relating to the fraction of found documents that were relevant), nor regarding time-on-task.

They conclude that this research provided evidence for the usefulness of computer-based tutorials for teaching certain types of knowledge (concepts and skills relating to on-line retrieval) and that computer-based practice sessions were not necessarily better than traditionally organised practice sessions (using pen and paper). They argued too that computer-based instruction seemed to enable law students to become more proficient in search performance and command language usage, and helped them achieve low time-on-task and high speed of using the command language.

Characteristics of a good authoring system

Authoring systems provide means for experienced computer users to create training packages without actually coding the computer. In the case of CBT an authoring system helps in the final production of the software but the specifications for the software have to be set by instructional designers, teachers of the course and professionals familiar with the authoring system: it is possible that this is the one person. Crowell (1988) outlined ten characteristics a good authoring system should possess.

1 It must be easy to use, yet allow creative flexibility. He points out though that a system that takes a little while to learn may have greater ease of use in the long run for the more experienced author than one a novice can pick up instantly.

2 It must utilise interactivity in its own design. The process of creating, testing, revising and re-testing a new idea must be efficient.

3 It must be good at creating both simple and complex interactive systems. A good authoring system will be just as fast and easy to use whether designing a simple or complex system.

4 It must support any learning theory and should be capable of using a variety of approaches to promote effective learning.

5 It must be able to call and utilise other, outside subroutines. While it is important for an author to be able to access other software from within an authoring system, it is even more important to be able to include such an ability in the interactive system being authored.

6 It must be hardware independent, not limited to only one hardware configuration.

7 It must be improved and updated constantly, to keep on top of a developing and expanding industry.

8 It should be useful at all stages of application development. The authoring systems should provide flowcharting, project management, script development and other resources.

9 It should be able to incorporate higher-level systems such as AI and expert systems, for example, to evaluate student responses much more effectively than most presently available authoring systems permit.

10 It should be able to accept new hardware as it is developed.

There are many authoring systems available, those that are powerful are generally expensive, the less powerful are often not worth their lower price, and in any case the development time is often long. In contrast to this HyperCard is standard software on Macintosh computers, no additional hardware or software is necessary, and powerful packages can be developed relatively easy and quickly.

HyperCard: An Introduction

HyperCard is a Macintosh application that can be used at various levels of operation. At its basic level users can browse through information stored in a HyperCard stack. Other users may wish to enter their own data onto some of the cards contained in a stack, or may wish to create a stack from scratch. Stacks can be very simple or can be complex data manipulation systems. HyperCard was created by Bill Atkinson (cited in HyperCard Course Manual, 1988, p1.6) who described HyperCard as:

> *an authoring tool and an information organiser. You can use it to create stacks of information to share with other people or to read stacks of information made by other people. So it's both an authoring tool and a sort of cassette player for information.*

The HyperCard Course Manual (1988, p2.1) describes HyperCard as

> *a personal toolkit that gives users the power to use, customise and create new information using... text, graphics, video, music, voice and animation. In addition it offers an easy-to-use English-language-based scripting language (called Hypertext) that gives users an opportunity to write their own programs.*

HyperCard can be thought of in terms of index cards. A collection of cards is called a stack. A stack consists of a number of cards that can contain all kinds of information. The information does not have to be related, although it generally is. Stacks that are sold commercially are referred to as stackware. The cards in a stack can contain a mixture of information media, in the form of graphics, text or sound.

HyperCard provides a unique information environment. It can be used to look for or store information in the form of words, charts, pictures, digitised photographs about any subject. Any piece of information in HyperCard can connect you to any other piece of information, so that you can find as little or much detail as you want. Refer to Table 1 for HyperCard terminology.

Card	A *card* is HyperCard's basic unit of information. Each card can contain information that is different to any other card.
Stack	A *stack* is simply a collection of cards.
Background	The physical appearance of a blank card is called its *background*. It is usual to have one style of background in any one stack.
Field	A card can have a number of *fields*. When HyperCard is asked to find a particular piece of information, it looks in each field during its search.
Button	*Buttons* are the devices that allow you to move from one card to another, they are the key to intelligent use of stacks; the key to the versatility and power of HyperCard.
Home Card	The *home card* is the management card, and contains a menu of stacks.
Help	HyperCard offers an on-line *help* facility: a stack which explains how to use aspects of HyperCard

Table 1: Important HyperCard Terminology

HyperCard fulfils the definition given by Crowell (1988) for an authoring system. For example, in HyperCard it is simple to create, test and revise cards and stacks, but complex and sophisticated packages can be created. It has its own authoring language (Hypertext) as well as other authoring aids which make the creation and revision of packages easy. HyperCard allows the user a great deal of flexibility including the possibility of being able to be incorporated with other technology, for example CD-ROMs.

Specifying the learning sequence for the HyperCard

Version of the Introductory LAWPAC Course

The Introductory Lawpac course is designed for new users of Lawpac. The knowledge and skills of Lawpac users covers a wide range. There are users who have had little contact with computers, on-line databases and legal information, and there are users who are very computer literate, are familiar with the techniques of searching on-line databases and have a good legal knowledge.

The objectives for the introductory Lawpac course are for the user to be able to:

- select a database
- examine the contents of the database
- choose a particular chapter or chapters of the database
- enter a search query
- refine a retrieved list with a subquestion
- use the SRL (swap retrieved list) command
- display the title of the articles in the retrieved list
- display the full text of the articles in the retrieved list
- display the search term in context in the articles in the retrieved list
- combine search terms using logical operators
- use positional operators
- search at named sections
- display named sections.

Several of these objectives can be grouped together into a single module, with each module a separate HyperCard stack. The names of the stacks are:

1 Introduction

2 General Information

3 Conducting the Search

4 Operators

5 Named Sections

6 Status Commands

Each stack contains a number of cards with each card connected to other cards in the stack, or to cards in other stacks, and to the home card. More detail about these stacks is given in Table 2.

STACK 1: INTRODUCTION
1.1 Introduction to HyperCard
1.2 How to use package
1.3 Handy hints

STACK 2: GENERAL INFORMATION
2.1 Lawpac contents
2.2 Computerised information retrieval
2.3 Areas of information retrieval
2.4 Accessing INFO-ONE
2.5 Logging on
2.6 Logging off
2.7 Database structure
2.8 Common words
2.9 The MORE? prompt
2.10 Parameters
2.11 Passwords
2.12 Help Desk facility

STACK 3: CONDUCTING A SEARCH
3.1 Problem stated
3.2 Using the menus
3.3 Selecting a database
3.4 Looking at the contents
3.5 Specifying particular chapter/s

3.6 Asking a question
3.7 Subquestions
3.8 Swap retrieved list
3.9 Truncation
3.10 Displaying titles
3.11 Displaying full text
3.12 Displaying in context

STACK 4: OPERATORS
4.1 Logical operator +
4.2 Logical operator ,
4.3 Logical operator -
4.4 Notes on logical operators
4.5 Positional operator //
4.6 Positional operator /n/
4.7 Brackets ( )
4.8 Precedence

STACK 5: NAMED SECTIONS
5.1 Sections
5.2 Searching at named sections
5.3 Displaying named sections

STACK 6: STATUS COMMANDS
6.1 AC
6.2 C
6.3 CHAP
6.4 CLIST
6.5 CONTENTS
6.6 D
6.7 DS
6.8 E
6.9 HELP
6.10 MAIN
6.11 PRINT
6.12 Q
6.13 S
6.14 SECTIONS
6.15 SQ
6.16 T

Table 2: Stacks and Cards in the Training Package

Three different backgrounds were used in the stacks: the first for information, the second for detailed command information and the third for command overview. Fields and standard buttons were designed for each of these backgrounds. General information cards have only two fields (title and information); command information cards have four fields (title, command name and function, search example and additional notes); command overview cards have five fields (command and function, explanation, syntax, when to use and several types of examples).

Individual cards that needed to be linked to other cards were given buttons as required. Each card has a Home, next card in stack, previous card in stack, previous card and go-back-to-the-start-of-this-stack button. A flow chart of all stacks and cards was made and additional relevant linkings indicated on it. Once the fields had been set up, it was simply a matter of typing in the appropriate information in the correct field and adding buttons where required.

A final feature of this HyperCard package is that at times users are asked to go on-line to complete a number of hands-on activities (for which answers are provided). This was designed to give immediate practice and feedback for the material just covered in the tutorial.

Conclusion

This HyperCard package has not been widely tested at this stage because system refinements were only completed in May, 1990. However it is possible to draw the following conclusions from personal observation and discussion with those who have used the package.

From the authoring point of view, HyperCard is simple to use in creating training materials. The instructional design can be time consuming and involved, but the conversion to HyperCard is a simple task. HyperCard is interactive and allows for user flexibility in designing and learning. One card can be linked to several related cards to provide further information on a particular topic which the user can access easily by selecting the appropriate button. Buttons give users the ability to refresh their memories on specific aspects of the on-line system without having to go through the entire tutorial by allowing for a variety of entry points into the training package. HyperCard allows for complex branching in training materials: each learner could complete the training materials in a unique sequence.

From the users point of view, the training package is easy to use because it contains features common to all Macintosh applications, and because HyperCard software is easily understood. So learning takes place in a familiar environment without the imposition of learning new commands before being able to access information from the package. HyperCard offers a high level of flexibility, allowing the user to follow the tutorial as is, backtracking if necessary, or going directly to a specific section and finding information as required.

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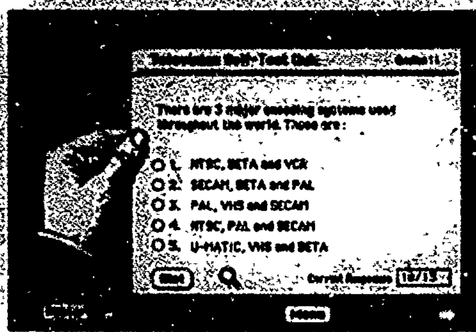
HyperCard Workshop

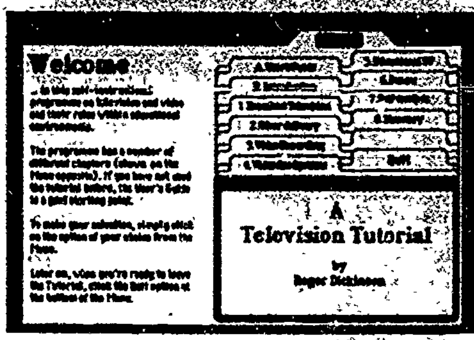
Roger Dickinson
University of Western Australia

The HyperCard program from Apple represents a radically new software direction which allows the integration of text, data, graphics, photographs, diagrams and sound in a user-friendly environment which offers unprecendented opportunities for educators.

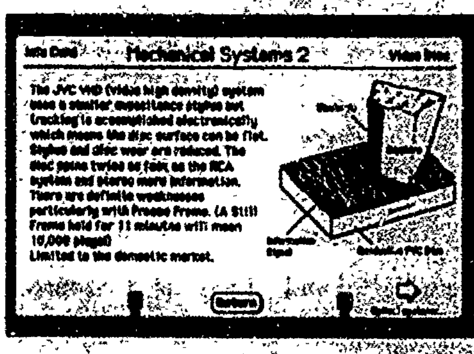
Roger Dickinson is investigating the potential role of HyperCard in the development of multimedia resource materials by producing and evaluating two interactive self-instructional tutorial programs. The development is being supported by an Apple Developer's Grant from the Western Australian Regional Computing Centre.



The first program, which will be demonstrated during the workshop, is a tutorial on video and television. It features different levels of difficulty, interactive glossary and directory, and a multiple-choice quiz with hints and scoring facilities. Evaluation of this tutorial will guide Stage 2: the development of a second tutorial to further exploit HyperCard's potential with enhanced sound effects, animation, graphics and interactivity. It will include a comprehensive assessment feature.



The workshop should be of interest to all educators interested in developing their own instructional and learning materials in a user-friendly, open-ended computing environment. The presentation will assume either no or minimal prior exposure to the HyperCard software.



SIULLEQ – a multimedia database about Greenland

Peter Olaf Looms
Danmarks Radio
(The Danish Broadcasting Corporation)

This paper covers some aspects of work with SIULLEQ, an interactive multi–media database about Greenland, its people, culture and wildlife. Following a brief account of interactive media in education in Denmark, the author deals with some of the technical and educational design issues that had to be faced during the Greenland project. The paper concludes with a discussion of the likely trends in educational multimedia in the next few years.

We live in a world characterized by change. In a material sense, our offices and homes have changed more in the last fifty years than in the previous five hundred, not least due to the widespread use of communication technologies.

Education — both in terms of its aims and means — is changing, too. Industrialization has brought with not only new requirements in terms of a skilled and flexible work force, but also new media. From chalk and talk and the occasional map or wallchart, teachers now make regular use of photocopies, audio cassettes, slides, films and video, reflecting the increasing importance of sound and images in our communication patterns outside school walls.

None of the technologies behind these educational media was developed initially nor exclusively for education. The audio cassette, for example, was a consumer product which found its way into the classroom in the early seventies when the price was sufficiently low, as did the video cassette ten years later.

Successful and widely–used resources in education have a number of characteristics in common: they are reliable, easy and cheap to use. Most of them are analogue rather than digital media.

With ten years to go to the end of the century we are in the midst of the transition from analogue to digital technologies for storing and distributing text, sound, images and video. Digital media hold the promise of distortion–free storage capable of withstanding the ravages of time. In the course of this decade, the transition to digital systems in the outside world will be almost complete.

For those of us working in education, the important question is when this transition will make itself felt in mainstream education, and how our work today with text, sounds and images can be transferred to the technologies of tomorrow. This is the context in which we have to discuss and evaluate interactive multimedia and their use in education.

Education and interactive media in Denmark

The interactive potential of the computer and disk–based multimedia in

Denmark is still the concern of an enthusiastic minority in Danish schools and colleges.

Work with interactive videodiscs dates back to 1985: the interactive use of videodiscs outside Denmark was such that they were included in the nation-wide distance education project for teachers called SKINFO. Produced by Danish Broadcasting and the Danish School for Educational Studies, this in-service training project dealt with the role of school in a world based on information technology. TV program five dealt specifically with interactive media applied to public information systems, education and training. It included coverage of the British Domesday Project and a mock-up of an interactive museum application about Greenland.

Interest in interactive media grew steadily from then on, although schools have been reluctant to invest significantly in the necessary hardware. Several factors account for this reluctance: uncertainty about microcomputer compatibility, optical disk formats and hardware configurations on the one hand, and relatively high costs on the other. The compatibility issue for microcomputers has become less critical, as schools have started to replace more than sixteen different makes of micro with DOS-compatible PCs, with the occasional Commodore Amiga or Apple Macintosh for specialized tasks.

Today (May 1990) there are more than seventy educational institutions using or developing interactive media using optical disc technology. Foreign language instruction predominates (Looms, 1990a), followed by local and environmental studies and interdisciplinary multimedia bases such as SIULLEQ and the NORDIC AREA '90.

	Six to fifteen year olds:
11	Local education authorities (primary and lower secondary education)
16	Voluntary out-of-school classes (ungdomsskoler)
3	County educational media or information technology centres
	Sixteen to nineteen-year olds
6	Upper secondary education and single subject colleges
7	Technical schools
2	Schools of commerce
	Tertiary education
7	Universities and teacher training colleges

Table 1: Interactive media in Denmark (DRIVE May 1990)

Ten schools have experience with the BBC Domesday Project, the Eco Disc or both and many more have experience with resource discs in biology, geography and astronomy from the USA (two screen configurations using HyperCard). Local education authorities in Aalborg, Copenhagen, Dragør, Herning, Køge, Odense, Ringsted, Sønderborg and Vejle have supported work with interactive video discs and we estimate that there are about 20 schools involved.

Observation of teachers working with existing materials by DRIVE has shown that gaining the necessary familiarity with the medium and specific materials can be a lengthy process. The first group to borrow a Domesday unit (four teachers) spent an average of 100 hours with the system before they felt sufficiently confident to use the material in class. Until the appearance of the Domesday resource booklets, teachers had little or no help in adapting existing IV materials to suit their needs. The major problem experienced was to come up with schemata for classroom management.

We have found it necessary to act as helpers as early as possible in the familiarisation process, giving suggestions of our own and establishing informal links with other teachers working with the same materials elsewhere in Denmark. In December, 1987 another three–teacher group were able to reduce their preparation time for a thirty–hour project to about 15–20 hours per teacher, of which three were spent with the author going through the retrieval facilities and discussing the adaptation of ideas in the "Projects and Topics" resource booklet. The group have written a detailed account of their project.

Work with the Eco Disc has involved producing new resources to allow a class to work as four or five groups. With BBC producer Peter Bratt's consent this has involved transferring side two of the disc (the original television programme about Slapton Ley) back to VHS, preparing supplementary texts containing transcripts of selected passages, putting the initial letters, newspaper cuttings and job description in paper form, and using the original Science Topics computer program, so that a class could split into groups and circulate among different work points, avoiding a queue at the interactive video workstation.

SIULLEQ — the background

Danmarks Radio began to make television programs about optical storage media in 1979. Initially they dealt with the potential of the LaserVision video disc and their use in Japan and the USA. Over the first few years the emphasis shifted from the technology itself to the interactive capabilities of optical discs.

In 1984, Peter Armstrong and his team at the BBC embarked on the now famous Domesday Project based on the LV–ROM format to celebrate the 900th anniversary of the Domesday Book. It was Domesday more than anything else that showed the potential of interactive multimedia and captured the imagination of educationalists.

By June of 1986 interest was such that DRIVE, then the acronym for the Danmarks Radio Interactive Video Experiment, was set up to report to television management on the implications of optical storage media for the Corporation.

DRIVE was asked to look into analogue and digital disc technology for our internal archives (both as primary storage and for "surrogate access" to picture and film archives), and for publishing.

Among the questions examined was DR's future role as a public service institution: should we confine ourselves to broadcasting and using the technology internally, or was there also a case to be made for expanding our publishing activities to include optical discs?

If there was a case for publishing, was there any evidence of synergy — publishing products based largely on radio and television productions and therefore keeping costs down?

In its report to television management in December, 1986 DRIVE highlighted several areas in which optical discs could provide cost effective solutions to internal archival problems. Some evidence for synergy in multimedia publishing was found (indeed, the case in 1990 is now convincing). We recommended a full-scale project to acquire first-hand experience in development and production. It was in this context that the idea of producing a multimedia database about Greenland was taken up.

Fourteen months later the project was approved, and DRIVE became the interactive media unit of Danmarks Radio. As DRIVE — indeed DR as an organization — did not have the necessary expertise in computer science, we joined forces with UNI•C, the Danish Computer Centre for Research and Education to tackle the Greenland project and jointly have sought additional funding for development work from public and private foundations. DRIVE has until the beginning of 1991 to demonstrate its viability. From then on it will be expected to cover its own costs.

SIULLEQ (Greenlandic for "the first") is an interactive multimedia database, the aim of which is to describe Greenland, the country, its people, culture and wildlife. The project is being implemented in association with the Autonomous Government of Greenland. Work on the project started in March 1988, and the full-scale working prototype, SIMILI, will be complete in June 1990. The final Greenlandic-Danish version will be available from the end of 1990.

SIULLEQ — design issues

There are five main stages — and costs — associated with a given any production:

- acquiring data (both intellectual property and data capture)
- structuring data
- distributing data
- accessing data
- updating data

We wanted to offer at least 30,000 stills and 30 minutes of video, as well as a minimum of two hours of audio. At the time of writing (May 1990) it seems likely that the total number of stills will be somewhat greater (40,000+) as we have been able to incorporate selections from key archives such as the Landsmuseum in Nuuk, Greenland, the Jette Bang Collection from the Arctic Institute in Copenhagen, the photographer Rolf Müller, the collections of the Royal Library and possibly artefacts from the collections of the National Museum. We also want to provide cross references to other important archives about Greenland, such as the Danish Radio sound archives (more than 940 recordings and programs dating back to the thirties, details of which are available in an on-line database) and DISØ, DR's on-line data base of commercially-produced cassettes, records and compact discs.

For large data bases such as SIULLEQ the cost of acquiring the rights to use and distribute information such as stills, video and text can be the major outlay, and thought has to be given to how large the database should be without making the cost of the final product prohibitive. A good case can be made for lower tariffs, as the probability of a given picture or text being used is far lower than in a printed work.

A simple solution to copyright payments for "La France et les Françaises le 14 Juillet 1989", a Compact Disc-Video videodisc containing 15,000 photographs by 300 French photographers taken last year to celebrate the two hundredth anniversary of the French Revolution was the inclusion of the names and addresses of each of the contributors and a listing of the frame numbers of each of their works. Those wishing to download material from the disc or to use photographic copies are expected to contact the photographer directly.

In the case of SIULLEQ, educational users downloading texts from the system in paper form for individual use will not be charged. However, each sheet of printout will contain copyright information on the author, as will downloaded low quality digital images from the CD-ROM. Should the material be photocopied it would be covered by the existing photocopying agreement. As we have gone to great lengths not only to use primary sources but also to include means of contacting copyright holders, we hope to encourage the responsible use of original material (Looms, 1990b).

SIULLEQ — defining the user interface

SIULLEQ was conceived as an interactive resource to cater for users in education (9+), libraries and museums in Denmark and Greenland. Since the original idea emerged from our television mock-up in 1985 we have had plenty of time to discuss and refine our ideas. The appearance of Domesday and interactive materials such as Eco Disc served as a common point of reference, allowing educationalists, content specialists, developers and publishers alike to exemplify and discuss specific aspects of the user interface.

Our original concept had much in common with Domesday: we wanted to combine the navigation conventions from the Community Disc (using maps of different scales) as well as a visual metaphor to allow users to search and browse through text, data, stills, sound, and video. SIULLEQ was also to offer surrogate walks, a Greenlandic–Danish dictionary and a toolkit to allow users to customize the system for specific uses. We feel that offering an open structure is fundamental to educational multimedia.

Work began in March, 1988 on a tentative specification for SIULLEQ, based on a virtual machine with various developer and end–user tools which was to be hardware independent. By defining the contents as objects and attributes, we could harness a powerful relational database and give the project team considerable leeway until fairly late in the process. The team initially consisted of staff from DRIVE and UNI•C, Aske Dam from IMA Norway, with persons seconded from the IT centre in Copenhagen and from the National Museum of Denmark, as well as editorial specialists.

Given the different backgrounds and working procedures of the team, a decision was taken to abandon a specification in June 1988 in favour of developing a small prototype for Sarfartoq/Paradisdalen (Paradise Valley) allowing the team to come up with a common frame of reference, at the same time allowing for the testing and modification of authoring and end–user tools. Looking back on our work, we would have benefitted from a full–blown prototype at that point.

In the SIMILI prototype to be evaluated from August until November 1990, users will have the opportunity to work in depth with three geographical areas. A number of presentations for users with limited background knowledge are on offer, but at any point users can choose to leave the "beaten track" and explore the material on their own terms. Our formative evaluation will focus on the use to which teachers, librarians and museum staff put the various authoring tools within the system, enabling them to produce new materials comprising digital images, graphics and texts from the CD-ROM and barcodes for running the video disc.

SIULLEQ — why Apple Macintosh, LaserVision, and CD-ROM(XA)?

In December, 1988, we were forced to decide on our user configuration. In the event we decided on two!

- a full-scale two-screen system based on an Apple Macintosh computer with a LaserVision player and CD-ROM (or if possible CD-ROM/XA) drive.
- a simple one-screen system based on the same LaserVision videodisc controlled by bar codes printed in one or more booklets accompanying the disc.

This choice was the result of trade-offs between:

- the media to be offered (text, statistical data, audio, stills, film, video)
- the total size of the database
- the storage capacity available for different optical discs
- the cost of the end user configuration
- the performance of the configuration
- migratory paths for future versions of SIULLEQ.

We were convinced that digital formats would at first complement and then replace analogue discs. The crucial question was how fast this would take place. A second issue was that of cost.

Discussions with educational authorities, libraries and museums indicated that institutional users were willing to invest in additional hardware which cost of the order of £1,000. The more our configuration exceeded this figure, the more difficult it would be to adopt it. Regardless of what we chose, computer-based multimedia were going to cost more than institutions felt they could pay. The only delivery system which is cheap enough today is a LaserVision player with barcode reader which cost exactly £1,000 in Denmark. Table 2 lists the configurations and disc considered at various points.

Computer	*No. of drives*	*Format*	*No. of screens*
Acorn Master	1	LV-ROM	1
Macintosh/IBM/ Amiga	2	LV + CD-ROM	1 or 2
IBM/ Macintosh?	2	LV + CD-ROM/ XA	1 or 2
IBM/ Macintosh	1	DVI	1
none	1	CD-I	1
none	1	combi-player with barcode reader	1

Table 2: Configurations considered for SIULLEQ

In 1986 it was hoped that the BBC LV–ROM format would catch on, so that we and others could adopt this as the common educational format in Europe. Although it is still by far the most common educational configuration in Europe, LV–ROM was not a commercial success, primarily because the drive never sold in large quantities and remained more expensive — and less flexible — than two separate drives. The Acorn BBC Master was also felt to be an exotic and limiting choice in continental Europe.

Although the appeal of the Commodore Amiga 2000 with its dedicated video and audio system as the keystone of a multimedia system was considerable, the scales tipped in favour of Apple Macintosh.

Although more expensive, the Macintosh offered an intuitive graphics interface and an environment with a powerful UNIX–like development system, MPW and MacApp. As a prototyping environment using HyperCard or SuperCard, Macintosh is still second to none. The consistency of the user interface from one application to the next, and the ease with which peripherals such as CD–ROMs can be used regardless of the Macintosh model were two additional key features.

We took a deep breath before dropping IBM, given its market position, but ultimately the lack of architecture standards when handling a range of media such as sound and graphics and the high cost of graphics cards such as Videologic's IVA 4000 were decisive. If SIULLEQ is successful in terms of its performance, and if funding can be found it should be possible to produce a DOS version.

From 1987 onwards we began to explore the possibilities of existing formats such as CD–ROM, and "vapourware", forthcoming formats such as DVI, CD–I and CD–ROM–XA.

The attraction of CD–I was the promise of a new generation of compact disc players for the consumer market, allowing for images and text as well as sound in four qualities. Institutional users could piggyback on this development and the delivery system would be easily within their means.

Even if we had chosen this low cost delivery system, eventually falling in price to about £200 by the mid 1990's, we would have needed to produce a series of between six and ten discs. The same dilemma faces the Spanish "500 Years After" project to be completed in 1992. Their feasibility study (December, 1988) envisaged either 1 LaserVision disc with two CD–ROMs or a series of six CD–I discs.

We discussed CD–I with Philips and with colleagues around the world from May to October 1988 before deciding against CD–I for the first version. The lack of developer tools, and our reservations about the lack of full–screen video at least as good as VHS were two of the key arguments against this choice.

DVI was even more difficult for us to evaluate. The argument against it last year was that the standards for image compression were unlikely to be defined in the lifetime of our project.

CD–ROM eXtended Architecture came to our notice in late August 1988. It seemed to offer many of the features of CD–I and a consistent migratory path from text to multimedia over the next few years. Again, the main problem was not that of standards but the lack of development tools ready for use by mid 1989. Apple was not forthcoming about its commitment to the ADPCM sound system which for us was one of the most attractive features.

The merits of a simple bar code version based on the LaserVision disc became clear as we followed the work of schools such as Rising School in Odense. A low-cost system provided an acceptable entry point complementing the full CD-ROM configuration. Users would be able to produce their own materials using the Macintosh at the local media centre and then use them for individual, group or class work.

At the time of writing, we still feel that the combination of LaserVision and CD-ROM/XA is technically the most flexible solution, although the cost of a LaserVision player and CD-ROM drive is at least £1,400.

Strategies for developing a market for interactive media — revolution or evolution?

In his presentation entitled "Multimedia — the New Frontier" in Paris last year, David Jones of Apple's European Multimedia Centre raised a number of important points about the history of multimedia, the market today and the need to offer benefits rather than features.

But by emphasizing benefits rather than costs, we risk excluding mainstream institutions such as schools and libraries by not offering them an evolutionary path, beginning with simple, low-cost solutions and allowing them to progress as and when they have the means to do so.

As Mogens Høirup (1989) pointed out in a recent paper

When publishers and producers of CD-ROM products embark on a new project, it is worth while keeping in mind funding available for teaching and learning resources. At Rising School with 600 pupils the annual budget for educational materials including paper, chalk, cassettes, hardware and computer software is DEK 600,000 (£53,100), or DEK 1,000 (£89) per pupil.

Using a computer to generate texts, to prepare worksheets with barcodes or to run standard applications may not be particularly sophisticated, but it allows users to build up experience and demand a greater degree of interactivity and better performance. As publishers such as Optical Data Corporation in New Jersey have shown, starting with video discs and then HyperCard stacks, leading to stackware on CD-ROM makes good educational and financial sense.

At the present time there is still a need for further "showcase" productions, demonstrating convincingly that interactive multimedia including CD-ROMs can offer us something we need, in a way which cannot be done as efficiently and cheaply by any other means. By offering learning resources which allow us to simulate real world phenomena that are difficult, dangerous or expensive to observe we are revolutionizing learning opportunities but at the same time democratising the learning process.

Domesday started this, and Eco Disc in its many guises (on LV-ROM, CD-ROM and now a two-screen LaserVision version with a HyperCard stac. , has consolidated the ground. Many educational multimedia projects are in the works and it will be interesting to follow their fate (Looms, 1990c).

The role of the teacher changes from that of information provider to learning consultant, setting the scene, paving the way, and helping students to consolidate their learning. All this makes considerable demands of mediators such as teachers, and they need to be given conditions conducive to making these changes.

Major commitments to revolutionary products do not come cheap. In a culturally diverse continent like Europe we need to come up with solutions which offer the cost advantages of centrally produced multilingual CD-ROMs and yet taking into consideration the very real differences from one country to the next by incorporating nationally or locally produced contributions. Learning foreign languages seems the obvious place to start.

Making use of interactivity is not something people choose to do of their own volition. Existing disk and cassette formats could be used interactively, allowing users to choose between a number of audio or video options, but this is by no means common. To date it seems that only the designers of video games have what it takes to sell the concept of interactivity to broad audiences.

Denmark Radio made an early commitment to teacher training both in educational broadcasts and inservice training courses and presentations. The user is not the object of our marketing efforts but a partner who has to be helped to make demands. Together we can produce worthwhile products.

This is why we with SIULLEQ are supporting both the evolutionary and the revolutionary route, hence our two configurations. As and when low-cost digital formats emerge, we plan to transfer our applications to them.

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Design, implementation, and transfer—the international use of instructional video: The cooperative development process of the Agency for Instructional Technology

John E. Nelson
Agency for Instructional Technology

The Agency for Instructional Technology (AIT) designs curricula and produces learning materials for schools in the United States and Canada. Established as an instructional television research project in 1962, AIT is charged with strengthening education through technology. AIT produces and distributes video, computer, and printer based instructional materials in cooperation with state, provincial, and international agencies. AIT is a non-profit organization located in Bloomington, Indiana, USA.

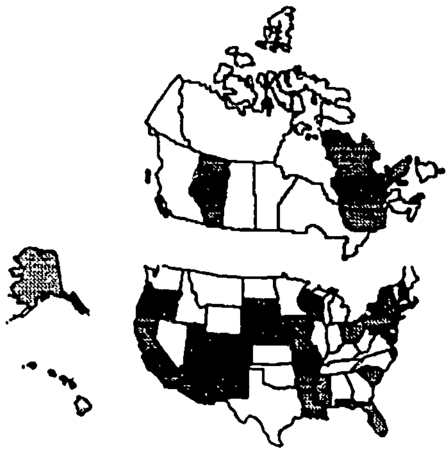
In the United States, the 50 state governments, not the Federal government, control education. Canada's ten provinces have a similar system. Thus, 60 different bureaucracies are responsible for education in the two nations. These state and provincial departments of education share common cultures and curricula and cooperate frequently in a wide range of activities.

AIT was created by them to manage their cooperative development of new curricula and production of learning materials using electronic technologies. AIT is a non-profit organization governed by leading educators from state and provincial education organizations.

AIT funds design and production of learning materials by forming a consortium of interested state and provincial education agencies in the United States and Canada. Thus far, 29 different consortia have created learning materials which are used throughout English-speaking North America and around the world.

A consortium unites as many as 60 education agencies in the design and evaluation of pedagogic materials; AIT manages the project and supervises production of materials. Subsequently, the schools within these member agencies have unlimited rights to use the materials in their classrooms.

These materials have been successful because the cooperating agencies have committed their time and energy, as well as their intellectual and financial resources, to make sure the materials are designed and produced to meet their own needs. The states and provinces are responsible for ensuring that teachers have access to the programming, are trained to use it, and have the necessary related resources to facilitate its effective use.



Members of MATH WORKS Consortium

The states and provinces make a significant financial contribution to the development of these materials. The 29 major sets of materials cost $33,565,656 to produce; the majority of the funds came from state and provincial fees based on student populations, other funds came from grants and AIT. The following chart illustrates the investment made by the entire system and two states:

State/ Province	*Number of Series*	*Participant Share*	*Total Cost of Development*
All 60	29	$25,360,481	$33,565,656
Alabama	11	$355,555	$19,253,882
Alaska	23	$311,966	$28,894,156

Alabama paid more for 11 series than Alaska paid for 23 series because Alabama has a substantially larger population. Note that Alaska received 23 sets of materials for an investment of $311,966; those materials are valued at $28,894,156. Obviously, cooperative development can be very cost effective. More importantly, each member of the consortium helps design and evaluate the materials.

Instructional Design and Formative Evaluation

AIT "strengthens education through technology" by encouraging the use of technology in the classroom, especially video. It also produces computer and videodisc materials and has, in the past, produced filmstrips and audiotapes. However, AIT does not emphasize the word "technology" in its name; rather, the emphasis is on "instructional." AIT relies heavily on the art of teaching and science of research, recognizing that how is as important as what students learn. For example, AIT instructional videos are based on several general considerations about learning

- Learning will increase if the learner understands explicitly what is expected.
- Students learn most effectively when they start with familiar situations before moving to new situations and problems.
- The greatest amount of learning occurs when skills are developed and practiced in situations similar to those in which they will be applied.
- Effective instruction emphasises active rather than passive learning.
- Effective instruction encourages the development of skills that are transferable from one context to another.

An illustration of students learning most effectively when they start with a familiar situation is contained in AIT's "Measurement: Finding Areas of Rectangles" from the MATH WORKS series. The program creates a scene easily understood by American pupils: two "target-age" children earn money by mowing grassy lawns for their neighbors (a common practice in the US). Because they base their fee on the size of the lawn, they must know how to calculate the area of a rectangle. The program follows them as they invent the formula "A = L x W" in the context of an everyday, not classroom, situation. The program is designed to emotionally involve viewers as they witness their peers using the discovery process to learn and practice in a familiar situation.

What do pupils learn from watching the program? The formula to determine the area of a rectangle? The skill to apply that information? The strategy to manage their own learning process? The desire to learn more about mathematics? As these questions suggest, learning involves more than just memorizing information. There are five broad categories of learning:

information — verbally reporting facts or generalizations

intellectual skills — applying learned information

cognitive strategies — self-managing learning

attitudes — choosing personal action

motor skills — executing bodily movement (Gagné, 1974)

The program "Measurement: Finding Areas of Rectangles" does not simply state the information "A = L x W" and tell the viewers to memorise it. By observation and subsequent classroom practice, students learn to use intellectual skills, such as problem solving, to apply known rules to new situations. They learn to use cognitive strategies, such as critical thinking, to manage their own learning processes. They develop positive attitudes towards mathematics by watching peers successfully cope with a difficult problem.

Teachers cannot create tools like MATH WORKS by themselves; they lack the time, materials, expertise, and funding. Successful learning materials must have high technical, creative, and instructional quality. They should be integrated with other media so that they complement other classroom activities. They should have a carefully considered sequence of instruction, with each lesson building on preceding lessons. Finally, the content of the series of lessons should be new enough to facilitate improvement in classroom practice, but not so new as to require disruption of existing curricula (Middleton, 1979).

These learning materials must be created by experts with the appropriate training and resources. For example, AIT's instructional designers cite the following principles of learning:

Active participation — encouraging students to think along with the presentation.

Sequencing — from the simple to the complex, the familiar to the unfamiliar.

Chunking — presenting the right amount of information for the development level of the students.

Congruency — eliminating whatever is not tightly relevant (Thiagarajan, 1988).

Adherence to these principles allows the creation of highly sophisticated materials. The MATH WORKS program features two children coping with a mathematical modeling problem. One of them has a rigid, literal perspective and cannot comprehend abstractions (this requires a cognitive strategy); the other child gradually offers enlightenment with the recurring use of one simple word: "pretend." The program also presents the same information about the mathematical formula in three different situations: drama, teacher lecture and animation. Thus, students are exposed to repetitive messages from different points of view, each presented in highly motivating situations.

The instructional design of AIT programming is verified and refined through formative evaluation by teachers and other subject-matter experts; subsequent production of provisional learning materials is based on that design. The preliminary drafts of scripts, videos, and teacher's guides are thoroughly tested in classrooms and revised as the research suggests. Formative evaluation focuses on four criteria: student **attention** to the lesson, student **comprehension** of content, the nature of classroom **interaction** stimulated by the lesson, and the **appeal** of the lesson to students and teachers (Middleton, 1979).

Teacher Planning

Once developed and released, materials must be accepted by teachers. Education researcher Bill Taylor (1981) lists five essential questions that teachers ask when selecting instructional materials:

Are these materials within my curricular area?

Will these materials be available when I want to use them?

Is the preparation time reasonable?

Are these materials compatible with my classroom management style?

Will these materials help me engage the interests and energies of my students?

Finally, Taylor quotes a teacher on the importance of immediate access:

> *Availability means nothing; accessibility is everything! Films are available in the county library -- so what? You have to order weeks in advance, and there's no guarantee that you'll get them when you need them. For teachers to use media properly and effectively, it must be accessible to them in the building -- at arm's length.*

Obviously, creating quality videos is not enough, by itself, to ensure learning. The distribution system must be as thorough as the development system.

With pre-produced instructional videos, a teacher can create a lesson that draws on resources far removed from the classroom. For example, sequences from GLOBAL GEOGRAPHY show deforestation in Nepal and resulting soil erosion and population shifts. Or, PRINCIPLES OF TECHNOLOGY sequences about mechanical resistance teach "drag force" by showing airplanes in flight, with graphic overlays illustrating the concepts. They teach "friction" by showing the brakes on the flight deck of an aircraft carrier stop a jet airplane — in two seconds. Through video, teachers can bring experts and their demonstrations into classrooms while maintaining control of interaction with the students and the way the program is shaped into learning experiences. By doing so, teachers are finding that more students are engaged in learning more of the time, that those who miss the impact of one method may be affected by another.

Final responsibility for and control of technology in the classroom rests with the teacher. Instructional video programs are designed to facilitate teacher adoption: a typical teacher's guide contains a summary of each program; a statement of objectives or goals; suggestions for preparatory activities; follow up activities; a glossary of vocabulary; lists of useful equipment; readings; and a textbook or curriculum correlation matrix. For example, The US versions of MATH WORKS and GLOBAL GEOGRAPHY contain charts in the teachers' guides that correlate the videos with units in commonly used math and social studies textbooks.

Delivery of Instructional Video Programs

There are a variety of delivery systems available: broadcast television, microwave, satellite, cable, and videocassette. Each has its own attributes and all can be used successfully to deliver programs to the student. Broadcast television, the original delivery system, is still a powerful force because of its ability to beam programs to a large geographic area simultaneously. A growing number of schools are recording programs off-air and keeping the tape in their libraries, giving flexibility to classroom schedules. Copyright clearances are prearranged in those cases.

Increasing, the videocassette is becoming the medium of choice because it permits teachers to control scheduling the programs. A videocassette player in the classroom permits the most accessibility, flexibility, and freedom for the teacher and class and allows the teacher to interrupt the program to answer questions and lead discussions. Another advantage of videocassettes is economy. It is far less expensive to supply thousands of classrooms with VCRs, monitors, and entire libraries of programs that it is to construct even one television station.

Accessibility to the programs is essential. A good instructional video can be useful for many years; each year a new group of students will be ready to view it. Therefore, the delivery system should encourage long term accessibility and use.

Adapting AIT Materials

AIT is actively seeking mutually beneficial curricula sharing projects around the world. For example, AIT worked with geographers and television crews in 14 countries to produce GLOBAL GEOGRAPHY. AIT also assists educators in other countries in importing learning materials that were originally developed for United States and Canadian schools.

To use AIT programs outside English-speaking North America, many changes may have to be made: translations, technical conversion of videotapes, and cultural adaptations. The adaptation process relies on the original AIT instructional design to produce quality, locally attuned, educational materials. AIT offers, and encourages agencies to use, its formative evaluation process during adaptation, ensuring that the new programs are suited to the new setting.

In some cases, English-speaking schools outside the United States and Canada use the programs. In other cases, the programs are translated, a local host is added, or new printed material is created to assist student understanding. Occasionally, new video footage is produced to ensure that the programs present local cultural values. In all cases careful attention is paid to the creation of programs that meet local curriculum needs.

There are several examples of this transfer of instructional technology. PRINCIPLES OF TECHNOLOGY is being adapted for use in nations as different as Australia, Bophuthatswana, Brazil and Mexico. In all four cases, AIT's design and evaluation methods are being used to enable producers to create materials that meet the special needs of each country. Just as this transfer of technology can be a shortcut for developing nations, more industrialized nations are also adapting North American materials to save time in the development cycle. For example, by adapting MATH WORKS and IT FIGURES rather than producing new programs, one developed nation was able to introduce its new mathematics curriculum ahead of schedule and under budget.

Those are two of AIT's three favorite phrases: "ahead of schedule" and "under budget." Of course, the first is "teaching."

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Rural & remote learning centres: The point of convergence for the provision of further education by alternative delivery systems

John Kirk
Adelaide College of TAFE

This paper discusses the development of community learning centres in rural & remote areas of South Australia and outlines how they have become the focal point for a range of learning delivery systems aiming to provide access, equity and participation for off-campus students in Technical and Further Education (TAFE) courses.

The philosophy behind their development is summarised in the following quote from Mr Peter Kirby, the Chief Executive Officer for the South Australian Department of Employment and TAFE.

> *... For the future we have to find creative solutions for the critical task of managing the resources of TAFE to produce greater access to a wide variety of programs all of which meet the needs of a diverse range of clients. ... It will mean breaking away from the constraints of buildings and fixtures. ... We will have to reach out with unconventional learning systems." (Open Learning Newsletter No.2, November 1989)*

Rationale for learning centre development

The development of the learning centre concept grew from a concern that people in South Australia's rural and outback regions lacked access to a wide range of TAFE courses. This concern was combined with the need to provide increased opportunities for interaction between lecturers and off-campus students, and to allow these students to interact with each other.

With the majority of mainstream courses offered being centrally located either in Adelaide or large country towns, the choice for country people was either to travel to the particular TAFE campus, use external studies print courses (where these were available), or simply miss out. The travelling often meant long hours on the road or a move to the city, and disrupted families and businesses. In many cases, the need to study is a legal business requirement.

For many students, studying alone using just print materials presents a daunting prospect, with the result that course drop-out rates are high. By providing a place with some simple but effective technology, the learning centres have met student needs for immediate feedback, interaction, and a group learning experience.

Early trials that were conducted with learning centres, indicated a range of other benefits for students studying this way. These included increased motivation, decreased drop-outs, and students being more responsible for their own learning. The use of audioconferencing also produced improved concentration and verbal skills.

Description of the learning centres

The learning centres vary according to local needs, but basically, they offer a space where rural people can travel a short distance to participate in a growing range of TAFE courses. For some students, this means being linked by telephone to an existing class in Adelaide or one of the country colleges, where they may be either alone, or with a small local group. Others study by watching videotapes of lectures, or by working through printed external studies materials with a local tutor.

Typically, the learning centres are located either within an existing TAFE campus, a local area school, or in a community building. Access is needed during the day as well as the evening. The centres aim to provide a warm, inviting atmosphere, catering for the needs of adult learners. Each centre is equipped with a DUCT[1] audio-conferencing terminal, a facsimile machine, video replay facilities, and a range of distance education course materials.

Some of the centres have already been equipped with specialist technologies as part of on-going trials (see the section on technology), and interactive computer links are currently being planned for others.

The centres are managed by part-time managers recruited from the local community, or by full-time TAFE lecturing staff as part of their duties. Through their promotion of the services offered by the learning centres, the managers have become a focus for TAFE in their own communities.

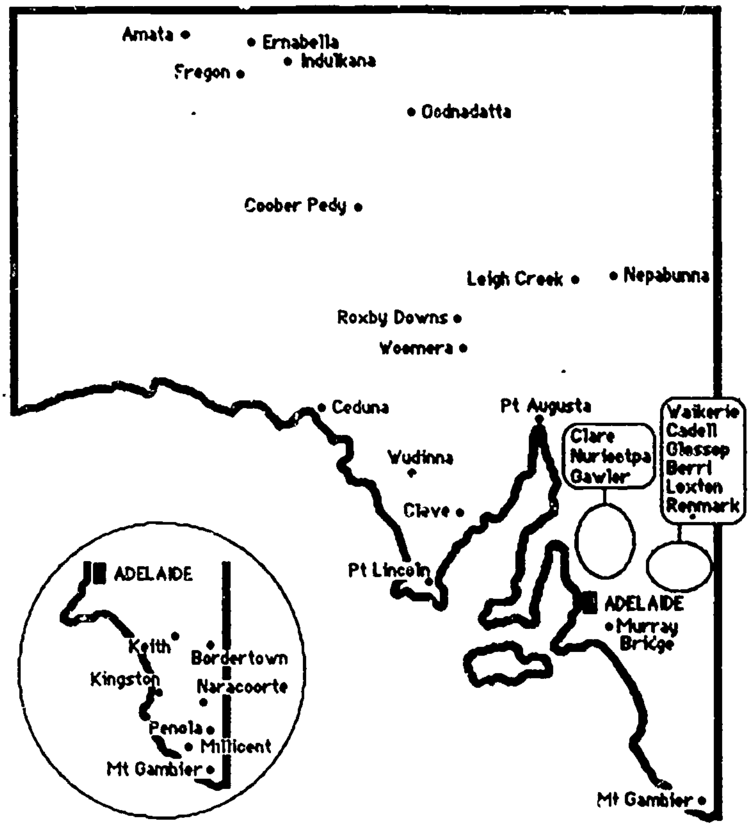
Extent of learning centre networks in South Australia

The number of learning centre networks based on country colleges of TAFE has expanded rapidly throughout South Australia beginning with the School of Aboriginal Education centres in June 1985, followed by the South East College centres in 1987. The networks now cover the majority of the populated areas of the state.

Aboriginal Education conducts courses in a variety of learning centres throughout the state, the South East College of TAFE has a network of seven centres, Eyre Peninsula College in the far west has four, the Riverland College is currently establishing five, Murraylands uses area schools, and Port Augusta in the far north has a network of five learning centres.

[1] Diverse Use of Communications Technology terminal developed by the SA Department of Education

SA DETAFE Learning Centres



Variations

Each of the colleges has produced its own variation of the learning centre model.

- Port Augusta College covers some 700,000 square kilometres of sparsely populated country in the north of the state. This area has an overall population of some 31,000 people living in a number of large centres plus numerous smaller towns, aboriginal communities and large pastoral properties. The distances are enormous and the roads are often mere bush tracks. Learning centres have been established in the TAFE campuses at Port Augusta, Coober Pedy, Roxby Downs, Woomera and Leigh Creek in order to provide more opportunities for the outback community.

The ever-growing number of courses delivered through the network make extensive use of audio-conferencing techniques. This includes the delivery of word processing courses by multi-point audio-conference for up to eight adult students studying on remote cattle stations. In addition to receiving their study materials, these students may receive a hands-free telephone and/or a lap-top computer on loan from the college resource centre for the duration of their study.

The majority of the courses offered in this manner are mainstream certificate courses. They include Introductory Accounting, Financial Accounting, Communication Concepts, Human Development, and a number of courses for office trainees. The Introduction to Tertiary Study is a popular offering providing a valuable link to adults wishing to undertake additional study, or return to study.

The centres are managed by lecturing staff as part of their normal duties.

- The Light College model has concentrated on developing open learning packages for students allowing them to study at their own pace, and in their own time. These materials are available from the learning centres which are located within the campus of each of the college's three branches: Gawler, Clare, and Barossa Valley (Nuriootpa). A few of the college courses are taught by audio-conferencing within the local network, while others are offered by videotape supported with on-campus tutorials with an itinerant lecturer.

The desire to supplement the range of courses available from the college, resulted in the use of videoconferencing to tap the resources of the much larger, metropolitan Adelaide College. This trial has proven most successful in that its level of both visual and aural interaction closely approximates the face-to-face situation. A diverse range of courses involving tutorials, role-playing, lectures, and practical demonstrations totalling nearly thirty hours each week, has been delivered to the country students in this way during the first half of 1990.

- The South East College has its learning centres located either within an existing TAFE campus (Mt Gambier, Naracoorte, Millicent), within a local area school (Keith, Penola, Kingston), or in a community building (Bordertown).[2]

Part-time learning centre managers recruited from the local community, tend to the needs of local students. They also act as a valuable focus for TAFE within the community, providing a service well beyond their ten paid hours of employment.

Students at both Light College, and the South East College make use of videotaped lectures supported by tutorials. Study groups with local tutors use external materials designed either by country college lecturers, or by external studies lecturers from Adelaide College.

Use is also made of audio-conferencing for courses provided both from within the country college, and from city colleges (eg Marketing from Adelaide, and Real Estate from Kensington).

- The Adelaide College's School of Aboriginal Education maintains a network of learning centres in Aboriginal communities throughout South Australia. It also conducts a number of classes by telephone to aboriginal people in the state's gaols.

The network began as a trial in 1985, and quickly spread to many remote communities in the following years. It covers some 13 centres catering for over 200 students. Not only was

2 The Bordertown learning centre is located in ***Hawke House***, the former home of the Prime Minister.

the network the first of its kind in Australia, but it was also the first to introduce facsimile machines as a means of providing rapid feedback during a session, and for transmitting student's assignments. The majority of the tele-tutorials are conducted by lecturers at the School's Wakefield Street campus in Adelaide. Here, a suite of rooms has been set up with three audio-conference terminals to allow classes to be delivered to different locations simultaneously.

The methodologies that have been developed, changed the thinking of many educators involved in aboriginal education, and have been adopted by many other institutions. The courses delivered by tele-tutorials and interactive fax[3] include literacy, numeracy, current affairs, community management, and aboriginal studies.

Technologies

The most common delivery method used in the learning centres, is a combination of audio-conferencing or tele-tutorials (some with interactive fax) together with printed study guides or learning packages. The public telephone network has been largely taken for granted as an educational tool. It has the capacity to provide a cheap, effective means of communicating with off-campus students. When combined with well-produced study materials, good teaching methodology, and a facsimile machine, telephone-based teaching is able to meet many of the educational needs in the community; especially for those people who are home-bound or who live in remote areas.

The provision of a telephone line, an audio-conferencing terminal and a fax machine, are the first requirements of all learning centres, and provide the back-bone of the network. VHS video replay facilities are also provided for students needing to view video-tape materials, either individually or as a group, and a range of the more popular external studies print materials are also stocked by the learning centres. Other print resources and practical kits needed for courses are available on demand.

In 1989, four of the most northern learning centres (Amata, Indulkana, Coober Pedy and Oodnadatta) were equipped with TVRO[4] satellite earth stations to enable them to receive a full PAL television signal from Adelaide College via Imparja TV in Alice Springs. This was part of a ten-week talkback television trial (one-way video with two-way audio by telephone conference link) undertaken to determine if the addition of a video image to an audio-conference would enhance learning.

A further development has been the installation of video-conferencing technology (two-way interactive video and audio) into three sites to determine the effectiveness of all participants being able to see each other as well as converse with each other. The Light College centres at Clare and Nuriootpa have been equipped with a compressed digital video link with the Electronic Classroom at Adelaide College for a video-conferencing trial during 1990.

3 The use of fax machines connected to DUCT terminals for the exchange of documents between sites

4 TV Receive Only earth stations for receiving the Remote Commercial Television Service from Imparja TV

Delivery styles & methodologies

Most lecturers using audio-conferencing with students located in the learning centres, aim to achieve a high level of interaction and participation. This is desirable from an educational point of view, as well as re-assurance that the students are still "on-line", and there have been no system failures.

The most popular methodology is the use of tutorials following the setting of work from a study guide or textbook. Ideally, the students are roughly at the same point in their study, and have common experiences to discuss with the lecturer and fellow students. Group sizes are kept to a manageable level of no more than 12-15 students, and sessions typically run for between one and two hours.

It is often believed that practical subjects or those including visual concepts cannot be learnt via the telephone. However, Word Processing A & B have been successfully taught at Port Augusta, and accounting subjects have been taught in a variety of places. The theory of diesel mechanics was successfully taught to Eyre Peninsula farmers using a combination of audio-conferencing, study guides, and facsimile transfers.

Role-playing also proved to be a successful way of teaching communication concepts by audio-conference from Adelaide College to students in various parts of the state.

People wishing to present lectures with minimal participation by students are encouraged to use either audio or videotapes of a regular class in action. These have been very successful with some business studies subjects when combined with print materials and group discussions on-site, with either local tutors or an itinerant lecturer.

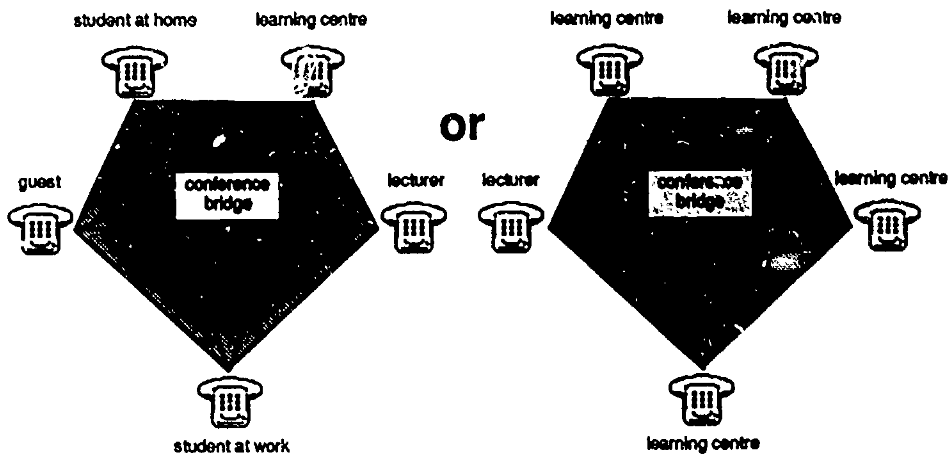
Audio-conferencing, through the learning centres, has also been used to share lecturing expertise between campuses, and for discussions with guests and VIPs. These people are able to interact with the students from the comfort of their own home or office, without having the expense or hassle of travelling to remote regions.

For most of the country colleges, a stipulated minimum class-size requirement prevents a number of courses from commencing in outlying branches. At least 15 students must enrol to justify a lecturer travelling to the branch to conduct the class. For many of the smaller towns and communities, these figures are unattainable.

The learning centre networks provided an ideal solution for this problem. Students within the college's region could enrol in the desired subject, and then travel to the nearest learning centre to be linked together into a class group by a telephone conference call. This aggregation had a significant advantage for the country colleges: the students that would have previously enrolled in external studies at Adelaide College, were now part of their local programs. They were also included in their statistics. In this way, the concept of hub or networked classes is a key factor in the viability of the learning centres.

The concept also allows courses to be conducted from any of the sites in the network. Classes do not always have to originate in the major centre or hub campus and local expertise can be available to all the students with a minimum of travelling and expense.

Networked classes



The talk-back television and video-conferencing trials predominantly used existing methodologies with a few modifications. Videotape material and graphics were used to enhance the tele-tutorial techniques by the lecturers involved in the first trial. Lecturers involved in the video-conferencing trial were encouraged to increase the levels of student interaction and participation during the sessions.

Support for the networks

Although not technically a learning centre, the communications centre (located in the Centre for Applied Learning Systems (CALS) at Adelaide College's Light Square campus) provides an important link with most of the networks.

Through the Electronic Classroom and adjoining rooms, the centre provides a base for lecturers to interact with off-campus students in a number of ways:

- Audio-conference facilities allow individual lecturers, lecturers with small groups (up to eight students) and lecturers with classes (up to twenty), to link with students in the learning centres or at home.
- A conference bridge can link up to five off-campus parties to any of the rooms in the communications centre for a total of six participating parties.
- The electronic classroom has an optical fibre link to Telecom's distribution centre for the delivery of a full PAL television signal to suitably-equipped centres and homesteads via the AUSSAT communications satellites. These interactive or talkback television classes can also be sent interstate, and internationally.
- Video-conferencing facilities are available to the Light College centres using compressed digital video through codecs and the Telecom public telephone network. These facilities can also be linked to any other compatible codecs worldwide.
- User-friendly, lecturer-operated video and audio recording facilities are available in the Electronic Classroom for lecturers wanting to

send information to students on video or audiotape.

Revised methodologies are needed to make effective use of these alternative delivery systems. The CALS Learning Systems and Instructional Design group (LSID) work closely with lecturers using these systems, providing training and advisory services to ensure a successful outcome.

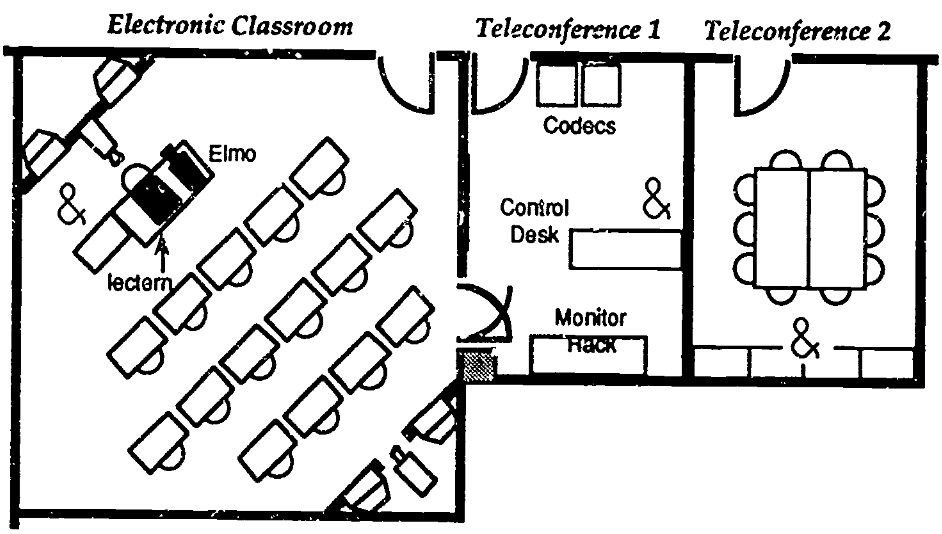
Effectiveness of the centres

There is no doubt that the learning centres have made a major impact on the way TAFE courses are delivered to off-campus students in rural South Australia. They have broken the constraints of correspondence and centralised on-campus delivery, and offered a flexible way to study a broader range of courses. The success-rate of the participating students is generally well above the average for on-campus groups, proving that this form of delivery is anything but second-rate.

The long-term viability of the networks, however, hinges on a number of critical factors as in the following list.

- The success of most networks relies heavily on the enthusiasm and dedication of a few lecturers. These lecturers need greater recognition and more rewards from college managers for their endeavours; particularly for the extra hours and effort required to plan and conduct sessions for off-campus students.
- Funding! All of the networks are run on shoe-string budgets. There is a need for both college managers, and the department's bureaucrats to place greater emphasis on providing adequate, on-going funding for the activities in the learning centres.
- Not all colleges have appointed learning centre co-ordinators. These people play an important role in training new lecturers to use the technology, assisting with organisation and planning, giving feedback on performance, and in choosing appropriate teaching methods.

CALS Communications Centre



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- Not all colleges have appointed learning centre co-ordinators. These people play an important role in training new lecturers to use the technology, assisting with organisation and planning, giving feedback on performance, and in choosing appropriate teaching methods.
- The effectiveness of the system also relies heavily on the willingness of lecturers to externalise their programs to include off-campus students. These methods must become part of normal course delivery, and staff recruited must be willing to participate in providing opportunities for off-campus students.
- The community at large still perceives that the learning centres offer a second-rate form of education. Their preference is for face-to-face classes, despite the very good results being achieved by students working through the centres.
- The management of the learning centres varies from college to college, although none of the managers works full time at managing a learning centre. The part-time managers feel that their effectiveness is limited by the number of hours available.
- The majority of TAFE courses are conducted in the evening after work, putting pressure on the learning centre managers, access to facilities, and on the students.
- The location of the centres is very important, and must reflect the wishes and attitudes of the local community. The local area school may not be ideal, as many adults have retained negative attitudes to schools. The centres must also be properly equipped to present a warm, friendly, comfortable study environment for busy people.
- The range of courses offered at present is hampered by a lack of suitable learning materials. Where possible, existing external studies materials are used, but these often need modification for audio-conferencing and other forms of off-campus delivery. More resources need to be

allocated to the preparation of materials and study-guides for off-campus use.

- Dissemination of information amongst the various networks is needed to avoid the duplication of resources. In addition, more information is required about course availability for off-campus delivery.

Even in the best of all possible worlds, not all needs can be met by the learning centres. This will always be a source of frustration for both the local managers and the students! However, the learning centres have become an integral part of TAFE's move to open up opportunities for rural communities, and as the industry restructuring demand for re-training and re-skilling grows, their role will become even more vital.

Appendix

Summary of courses

- Communications studies for certificate courses in business studies
- International Principles of Marketing between Adelaide, Pt Lincoln and two centres in the USA
- Certificate of Rural Office Practice (CROP), & New Opportunities for Women (NOW) courses for rural women
- Real Estate Certificate subjects
- Introductory Accounting & Financial Accounting 1 & 2
- Diesel Mechanics (post-trade certificate)
- Rural Farm Management
- Certificate of Farm Practice
- Adult Literacy & Numeracy
- Matriculation English, and Japanese Conversation
- Word Processing A & B
- Office Trainee courses: Bookkeeping 1, Work Environment, Clerical Procedures
- Introduction to Tertiary Study
- Human Development
- Micro-computer Operations
- Aboriginal Education courses:

  Adult literacy for remote aborigines

  Community management for remote aborigines

  Communication studies for prisoner education

  Introduction to Vocational Education certificate courses
- Light College Video-conferencing courses:

  B· ·iness Law

  Computer Applications (Theory)

  CROP

  General Office Practice

  Rural Communications

  Customer Service & Sales (Tourism)

  Communications (Business Studies)

  Business Economics

  Small Business Management

  Women's Studies/Community Care

  Rural Property Planning

  Building Practice

  Pesticide Applications & Safety
- Staff development & training for lecturers in rural campuses

Special projects

- Aboriginal Education tele-tutorials (1985 -)
- Interactive Talkback TV via Imparja TV & AUSSAT (1989)
- Rio Salado International Marketing tele-classes (1989 & 1990)
- Hong Kong Introductory Accounting (1989)
- Light College Video-conferencing (1990)
- The Electronic Classroom of the Future (1990 -)

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Electronic mail: Is it intrusive or invisible?

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This is the saga of how thirty qualified teachers came to grips with using Keylink during their full time post graduate teacher-librarianship course. The experience was intended to introduce the participants to technological change. It should also give them confidence in using an unfamiliar technology in an educational situation.

A participant must go through six stages before the technology becomes nonintrusive and mental concentration can be directed toward creative application of 'invisible' technology to educational needs.

The Keylink project also provided an educational activity to promote International Literacy Year in schools. About three hundred children in at least thirty schools became involved in the project.

Information and technology

Access to information is power.

> *And since knowledge is power in liberal ideology, the information revolution fulfils two of the prerequisites of a democratic state: freedom of information and growth of literacy (Brants, 1989: 93).*

To have access to information one needs to overcome the mental barrier of using the technology. Techniques for seeking information through indexes to books, electronic data bases, and other resources should become automatic. Technological phobia often makes technology or equipment intrusive and prevents some individuals from fully participating in the information of their culture.

> *Technology has changed the shape of time, space and culture. New transportation and communications technologies have altered our sense of distance. Information technology has distinctly influenced our sense of the present, the latter being no longer limited to one event in one place, sandwiched tightly between past and future and limited to local surroundings. (Brants, 1989: 81)*

Electronic mail provides one method of communication using technology. Messages arrive immediately they are sent and wait for a convenient time for the receiver to read the message. "Computer conferencing systems are offering a 'time and space independent' way of communication." (Romiszowski & de Hass, 1989:8)

In order to cope with future sources of information today's children should be exposed to current hardware and software to access information. The library or resource centre can provide a gateway for reaching well beyond the local school environment. Murr and Williams look to the time when "Library," as a place, will give way to "library" as a transparent knowledge network providing "intelligent" services to business and education through both specialized librarians and emerging information technologies (1987:7).

Teacher-Librarians and information technologies

Teacher-librarians, as information specialists, have a responsibility to teach their students how to access information from a wide variety of sources. Telecommunication technologies in the form of computers, modems, telephone lines and computer software provide just one source for connecting people with information.

> *Telecommunication sophistication will, more than any other single element, make or break the prototypical library of the future. (Murr & Williams, 1989:19)*

It is a responsibility of the teacher-librarian to understand how telecommunications technologies operate. They also need to know how to apply this knowledge to the school curriculum.

Learning technological processes

"For most teachers, 'educational technology' still implies devices - hardware and associated software" (Kerr, 1989:7). It is necessary for a teacher to realise some educational value for using the technology before it will become part of an instructional strategy. Meanwhile, teachers are feeling pressure to introduce students to computers and their use in the world beyond the school.

Learning to use technology can be a debilitating experience, however, the use of technology to access information is important. "Technology should be the means by which teachers and students are able to feel more empowered and in control of their lives" (Valdez,1989: 38).

At the early stages of using technology to access or present information a teacher tends to be overwhelmed with the hardware and software - it is intrusive. Only after mastering the hardware can creative planning for meaningful learning experiences move to the forefront. Marker and Ehman found teachers can not be expected to

> *learn how specific technologies (electronic mail, modems, learning circles) work, and invent their classroom applications at the same time, without wholesale confusion and frustration by many (1989:28).*

In a project using Telecom's electronic mail system Keylink, adults learned to use and apply technological systems to communicate with children.

The Project

Teachers and students used a Keylink based project Characters-on-Line devised by Jenny Gallaghan of the Queensland Education Department.

This project provided experiences with electronic mail and was implemented through the Teacher-Librarianship Course at Queensland University of Technology, Kelvin Grove Campus.

Thirty qualified teachers commenced full-time study for the Graduate Diploma of Education (Teacher-Librarianship) at Brisbane College of Advanced Education (now Queensland University of

Technology). Part of their *Media Production and Use* unit involves use of Keylink to communicate with school children. The Characters-on-Line project provided an excellent opportunity to practice using Keylink.

Teachers and teacher-librarians in schools throughout Queensland were advised the project could be used to promote literacy in this **International Literacy Year.** Within eight weeks of the commencement of the school year almost 30 schools from all over Queensland, and one from New South Wales, had used Keylink for students to send letters to Wilbur the pig. Wilbur is a character from *Charlotte's Web*, a popular primary school fiction book by E B White.

Messages with questions from students were sent to a dedicated Keylink mail box and the teacher-librarianship participants responded to the letters as the character of Wilbur. The questions and answers were uploaded to a Bulletin Board which was available to any interested Keylink user.

Selecting the participants:

During the first week of the course a lecture to explain and demonstrate electronic mail and Keylink was given to the thirty participants. Only 10% of the participants claimed to have heard of electronic mail before this lecture!

At the conclusion of the lecture six female participants volunteered to be members of the first group to explore the technology and use Keylink to communicate with children. The remainder of the class opted for introductory sessions on word processing.

As expected, the group of six were all somewhat computer literate and had varying degrees of word processing skills. Three owned a computer and one had her own modem. This was a great advantage as there were difficulties accessing Keylink in the early stages.

Later in the semester these six participants wrote a users manual and instructed the next group who took on the role of another character. By the end of the semester all participants had experience at least three weeks of Keylink interaction.

Strategies:

The Mathematics Department provided a laboratory with fifteen terminals connected to a mini-computer and one modem access for the Department and this laboratory.

During the first week of classes five hours were timetabled in the laboratory where wordprocessing and Keylink access were demonstrated. The six participants were encouraged to prepare and send messages. It was suggested they work as a team to learn skills and devise strategies for communicating in the role of a Pig.

Excitement was high and the participants decided Wilbur would arrive earlier than advertised as they were keen to make meaningful use of the technology. Sending and receiving letters was exciting.

Letters:

A week ahead of time the following message was put on the *Wilbur.bb Bulletin Board* in response to an expression of interest from several schools:

Subj: WILBUR'S HERE

Wilbur is so radiant about the enthusiasm shown by your response that he has decided to leave his manure pile earlier than expected ("some pig"). ~

He would love to receive your letters as soon as possible.

The first set of questions and response follows:

Posted: Fri Feb 23, 1990 12:37 PM EST Msg: MJJA-1994-5484

From: ILY.PO

To: ss.bohlevale.std

CC: wilbur.bb

Subj: wilbur answers

We have some questions for you Wilbur.~

What's it like in a manure pile?~

What's it like being chased by lots of farmers?~

What do you get for dinner?~

What's it like being a pig?~

When and what were you given for the fourth meal?~

How did you like it with so many people around?~

What's it like leaving Fern?~

What's it like being sold to Mr. Zuckerman?~

Did you like it in the muddy pig pen?~

Dear Daniel, Ben & Thomas,~

So nice to hear from you. It's good to be in Queensland and to meet lots of new friends. The manure pile was warm, comfortable, good to lie on and especially good to jump from.

I didn't like being chased by the farmers; I was scared and frightened and all my friends were confusing me with all their instructions.~

Mostly for dinner I get slops. They're delicious, and I especially like the days when I get warm milk, potato skins, toasted cornflakes and wheat middlings.~

Being a pig is fun, you get to lie in the manure pile, get fed, and meet new friends in the barn.~

I enjoyed having so many people around as I was lonely when I had few friends.~

I didn't mind leaving Fern as she is really always with me in my memories.~

I was a little sad and lonely at first, but then Fern came to see me quite often, and I did get to know Charlotte, which you know was a very important part of my life.~

I was given milk and slops for my fourth meal, I think. (When you get to my age, your brain is not as reliable as it used to be.)~

I liked the muddy pig pen, it was my home and I didn't like being away from it.~

Well, I sure enjoyed talking to you, hope I have answered your questions. Please get in touch if you have any more.~

Bye for now,~

Wilbur~

After the initial responses the participants became less conscious of the technology and their correspondence became more interactive as they asked questions of the students which required follow up letters to Wilbur.

Some Restraints

The participants were studying full time and heavily committed to preparation of assignments for other units of work. The Keylink project appeared to take extra time and effort. Certainly extra mental effort was required to learn new skills and understand the technology, this involved continuous hours of concentrated time.

In the schools a program was already in operation. Especially in the secondary schools it was difficult for teachers to adjust their timetable to accommodate a non-programmed fiction book. Primary teachers needed longer time notification to introduce students to the book and arrange letters to be written to a particular characters.

Many schools did become heavily involved in the project and arranged themes around the selected book. Several libraries produced a spider web and attached Keylink responses to the web for the children to find.

In these cases it was often the school secretary who had the pleasure of sending the messages and receiving the responses. Some children were not fully aware of the intervention of the computer and operation of Keylink.

The results

The Teacher-Librarianship participants wrote of their experiences and ideas for possible educational uses of electronic mail. Some responses showed the students had not moved beyond a concern with the technology itself. The Technology was still intrusive. Other students experienced excitement and anticipation of further curriculum applications for electronic mail. The technology was invisible.

Of the initial group of six participants, three were still excited about the project after six weeks of accessing Keylink. Initially these participants were 'phased' by the project and there were technological teething problems which only stimulated these individuals to rise to the challenge. They now find Keylink easy to use and the technology has become transparent.

The use of Keylink to communicate with students provided meaningful interactions and the use of this technology has already been transferred to other technological situations. One participant has gained confidence and overcome her 'computer phobia'. Another said it still allowed her to communicate with children even though she was attending full-time study.

The other three participants could not cope with the technological problems and lack of direct constant guidance. They maintain the technology gets in the way and the experience was not worthwhile for them or for the school students.

For these participants, facsimile is a better medium, with its ability to instantly send messages which are immediately received in the school. In addition, appropriate formating and children's drawings can be sent with the written message. Another failing of the Keylink system, in their minds, is the access within the school. Normally the modem and computer are located in the administration office where the secretary types and receives the messages at her convenience. The children are not involved in the technology.

In some schools this equipment is available in the Resource Centre and students directly access the electronic mail system as part of the educational curriculum where they explore communication systems and technology in society.

Discussion

Valdez identifies "three stages that most people experience when learning to use technology for educational improvement" (1989:37). They are "awareness", "adoption" and "refinement/adaptation". The current research suggests six stages adult learners experience as the technology moves from the intrusive to the invisible:

Stage 1: Awareness

Stage 2: Learning the process

Stage 3: Understanding and application of the process

Stage 4: Familiarity & confidence

Stage 5: Adaptation to other contexts

Stage 6: Application to new contexts

Stage 1: Awareness

Information about electronic mail and an explanation of Keylink was presented. Only 10% of the participants had heard of Electronic Mail.

Some felt bewildered, fearful and concerned about their compulsory involvement in hands-on use of Keylink. Others were eager to become involved. At this stage they became aware of some possible uses for electronic mail.

Stage 2: Learning the process.

The time consuming process of assimilating new information and mastering new skills epitomised this stage. Instructions were often misleading for the novice who did not understand the process.

Frustrations with technology failure rendered the equipment intrusive in the eyes of the user. The technology overpowered the curriculum application.

Some participants, without extensive computer experiences behind them, were afraid of damaging equipment. Others, in hindsight, enjoyed this challenge and persevered to ably move beyond this stage. There was general agreement that the benefit of working with a team was extremely important. Moral support was essential.

Stage 3: Applying the process

Everyone reached this stage. Though 10% did not seem to fully understand what was really happening - they learned to follow instructions.

At this stage the rigorous following of instructions is relaxed as the participant began to understand what was happening and realise the meaning behind the instructions.

Stage 4: Familiarity and confidence

The technology became transparent as the participant felt the sense of satisfaction and excitement which comes with successful achievement. Problems were no longer major distractors, they became "hiccups".

Stage 5: Adaptation to other contexts

Now the participant reached new understanding with confidence to move from concern about the technology to thoughtful creative applications for educational purposes.

Experiences learned are transferred to other contexts. One participant reported a new sense of confidence when she assisted school children as they learned a wordprocessing package; especially as this was a package she had not experienced herself.

Stage 6: Application to new contexts

This stage will be reached by those participants who use electronic mail in the future to satisfy an educational problem.

Knowledge that success has been reached in the use of this previously unknown technology will empower the participant to explore the educational potential of new technologies as they appear on future horizons.

Conclusion

Teacher-Librarians are increasingly finding themselves using computers for access to information. Some have automated library circulation systems, others are looking to CD-ROM data bases being readily available to their students. The use of a computer with a modem to communicate over distance is a technique for taking learners beyond the confines of their physical school environment.

The experience with Keylink has been a success for the Teacher-Librarianship participants and also for the teachers and children who took part in the project. The participants are aware of electronic mail and many of them are looking forward to implementing their educational ideas in the future. They also have an understanding of how to explore new technologies and most will be willing to participate in educational innovations involving technology.

Schools participating in the project have developed related themes of work and extended the learning experiences to areas beyond characters in the novels.

Does technology intrude upon the process of communication? For some participants the technology was difficult to manipulate and their whole mind was immersed in trying to 'do it right' rather than explore the educational implications. The technology remained intrusive.

There are a number of stages individuals need to go through before technology becomes invisible and creative applications can be incorporated into the educational curriculum. Once these stages have been transgressed the benefits of the new technologies can be applied for the benefit of learners.

In the future the technological innovation may not be electronic mail, but another technological application which will need to be explored before it automatically becomes incorporated within the educational environment.

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Developmental user groups for ongoing computer training

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A perennial problem for training and development departments is the support of non-professional computer operators beyond initial training. This paper describes a user group solution implemented at the UNSW for operators of popular word processing packages. The design of the groups, the experience of running them, and some lessons learnt are discussed.

It is clear that the implementation of office technology is not a sure fire recipe for increasing productivity. In fact, the productivity of white collar work appears not to have improved since the sixties, despite massive investment in computers and computer aided communications. (Bowen, 1986, p.267) A major study of 2000 companies in the United States that had implemented new office systems showed that at least 40% of the systems failed to deliver the intended results. (Bikson and Gutek, 1984) Only 10% of these failures were attributed to technical failure. Human and organisational causes dominated. Whereas technical failures and software deficiencies were once seen as the major causes of office system shortfall, the issues now seem to be organisational and managerial. (Levinson, 1985)

One of the many human resource issues that office computerisation raises is training. (Kling and Iacono, 1989, p. 346) It is also one of the issues that is most easily misunderstood. The following is a typical assessment:

> *"... providing the necessary training and education is a much more complicated and difficult task than it may appear to be at first glance. This is because several types and levels of training and education are usually necessary in order to realise the full benefits of the new system. First there is the relatively straightforward matter of what buttons to push. ...But beyond that, users need to understand the relationship between the technology and the organisation, which will better enable them to utilize the full potential of the technology."* (Long, 1989, p. 329)

While we may agree that the training task is more difficult than usually thought, the difficulty does not *only* lie with the broader educational goals. The 'straightforward matter of what buttons to push' is, on closer examination, not so straightforward.

It has become almost a commonplace that most real world users of computer software packages, such as word processors, use them at only a fraction of their full capacity. Sometimes this is expressed by bemoaning the excessive number of features the developers now include in the packages, noting as we do that we shall only ever use a few of them. The other side of the coin is the stereotype of the user who 'uses the computer like a typewriter'. Indeed, getting stuck in a rut is a common fate for many users, though they usually only dimly recognise the fact.

The under-utilisation of the features of software packages may involve a considerable loss of productivity. I say 'may' only because most packages are intended for a range of applications, and no one situation demands the use of all features. Yet often it is the most basic features of word processors that remain untouched: tabs, style sheets, templates, and mailmerge. Many users develop elaborate strategies to accomplish the tasks that these features are designed to automate. They spend hours formatting with the space bar, and then more hours re-formatting when they discover the necessity to change a margin. They re-type letters to different addresses, when a mailmerge or template would accomplish much of the work in a tenth of the time. This is the level that many users, many of us I am sure, operate at more often than should be admitted. Clearly this situation implies productivity foregone.

The situation also poses a problem for those exercising the training and development function within an organisation. Whilst initial training in the use of packages is often organised and usually seen as necessary by the organisation, ongoing training via courses is expensive, of dubious value, and hence difficult to justify. Yet while formal training enables initial skill development for staff new to packages or computing, it rarely provides the conditions for autonomous and continuing development thereafter. The need for ongoing development and support of operators persists and needs to be addressed if the full benefits of the systems purchased are to be realised.

A way of addressing these ongoing training and support needs is via development oriented computer user groups. But some changes to the familiar concept are necessary to make them effective.

Computer user groups

Computer user groups have been around almost as long as micro-computers. The earliest groups started in the United States in the mid seventies. They arose to fill the gap between the need for information and support and the provision by manufacturers and formal education channels. In many ways their existence is an indication of the poor quality of support given to users by manufacturers, and by software distributors. In 1986 there were approximately three thousand such groups in the United States, ranging in size from 10 to 10 000. The Toronto PET user group had 15 000 members in 1986. (Kugelmass, 1986, p.32)

User groups are generally private affairs. They are usually started by enthusiasts who meet to share information and resources, and to solve problems. As they grow larger they develop formal organisational structures, and a wider range of services. They often publish newsletters, distribute software and maintain bulletin boards.

User group meetings too have a typical structure. They usually open with announcements, then allow a period of questions and answers, followed by a coffee break when members meet to discuss, and often solve, the problems raised so far. After the break there may be demonstrations of techniques, new software or hardware, or a guest lecture. The formal meeting is often followed by meetings of special interest groups. (Powledge, 1984, p.97)

Most user group form around a brand of computer, or around an operating system. Thus there are, or have been, Apple, IBM, PET, Kaypro and Tandy user groups. Likewise MSDOS, Unix and Macintosh groups have been run successfully. More recently some groups have formed around specific software packages. In NSW, for example, there is a state wide Word Perfect User's Group. In many cases the groups provide a hedge against the vagaries of the computer industry, providing support unavailable from the manufacturer, and after the manufacturer has ceased to exist.

The high proportion of enthusiasts among members can lead to problems. Many new members are "... overwhelmed by the technical banter and do not return after the first meeting." (Kugelmass, 1986, p.30) To overcome these problems some groups ask novices to arrive early so their concerns can be addressed separately, in other groups novices gather after the formal meeting as a special interest group. (Powledge, 1984, p.97)

Little has been written about the place user groups can take in an organisation's training and development strategy. While it is certain that corporate user groups have existed for some time, they are usually informal gatherings, even if officially sanctioned. Indeed the line between formal corporate user groups and informal, on the job support and mutual help is usually very thin. Corporate user groups also tend to share the characteristic of their private counterparts in being oriented towards hardware, albeit that available and in use in the workplace. (Brandt, 1987, p.28)

The context of the UNSW user groups

The University of New South Wales is comprised of a large number of relatively autonomous units, Schools, Departments, Research Units and the like, spread over four major campuses. A relatively small central administration provides support and coordination functions.

The Higher Education Sector has come under increasing pressure in recent years. Funding has been cut in real terms, and is now at levels per full time student similar to those experienced, and deplored, in the early 1960s, despite increases in student numbers. (FAUSA, 1989) Income is increasingly being generated by accepting full fee paying overseas students, and by entrepreneurial activities, both of which involve additional pressures on staff.

As would be expected there is a central computing department which operates a range of mainframe and minicomputers for academic and administrative purposes. It also provides user support services to all users, as well as a small PC support group mainly focused on technical issues. It is not directly involved in the training of PC users.

While the central PC support group offers advice and assistance to staff selecting and purchasing microcomputer systems, there is no standard policy concerning hardware or software packages. A broad, though narrowing range of micro computer hardware and software is thus in use across the university.

Training and development for all staff is coordinated by the Professional

Development Centre, an academic unit set up with human resource development as well as traditional academic responsibilities. Ultimate responsibility for training and development lies with staff and managers, with assistance available from the Centre and a number of other specialist units.

The Centre organises training courses for staff in a range of commonly used word processing packages such as Word Perfect and MSWord, as well as in MSDOS and other computer related topics. It also maintains a self access facility, in which CBT and video training is available for a number of packages, and a library of training materials for loan to staff and work groups. It supports the user groups which are the subject of this paper.

The University employs approximately 2 500 general staff. Many are in clerical, secretarial and administrative roles. Many are expected to use microcomputers as part of their work, mainly for word processing. Few are fully qualified word processing operators. They are also among the lower paid workers of the University.

A proportion work in 'isolated' locations, often in one person offices. While they may work on the main campus, or on another in the Sydney metropolitan area, they are organisationally quite remote from the central administration. Their isolation can be intensified by being the sole general staff member in a unit otherwise made up of academic staff. This means that they work under very different working conditions, and their performance is much more closely monitored, albeit informally. The work pressures can be very great. Their work areas are often understaffed and there are few mechanisms in place to control or limit the workflow. It is not unusual to find a situation where many people allocate work to them directly, without any overall coordination or control.

Others work in the central administrative section where organisational or physical isolation is not a problem. Yet even here complaints of under-staffing and high workloads are often voiced, and the alienation commonly felt by those lower down the hierarchy in a large organisation is not unknown.

Another facet of the isolation experienced by these staff, is their effective isolation from other users of the computer packages they work with.

The history of the user groups strategy

The inclusion of user groups within the university's computer training and support strategy stems from a recommendation from the Staff Development Unit (a forerunner of the current Professional Development Centre), in 1985. This recommendation followed, among other things, a training needs survey which had identified at least 25 separate wordprocessing packages in current use.

Groups commenced operation in the middle of the same year. Ten groups were started, covering the following software packages: Word (two groups, one MSDOS and one Macintosh based), Type-Rite, Unix, Spellbinder, Multimate, Apple, Wang, Word Perfect and Wordstar. An additional group, potentially comprising some sixty members, using a variety of other packages was convened in an attempt to meet their needs.

The agendas of the initial one hour meetings of all groups was the same:

- Welcome and introduction of members and of the user group idea.
- Announcements (including the results of the training needs survey).
- Demonstration.
- Information on getting supplies.
- Tea/coffee and informal discussion. (members were invited to bring their lunch)

Each meeting was 'chaired' by a member of the Staff Development Unit who acted as a facilitator, while staff from various units demonstrated techniques. Much of the administrative and technical support for the groups was provided by the Head of the University's Word Processing Section. Staff members attended in working hours, and were welcome to stay for informal discussion during the lunch hour.

In all approximately 100 out of an estimated 275 staff members in the target group were involved in these initial meetings. After each meeting an invitation was issued for the next, with written responses to queries raised attached.

In 1985 and 1986 the groups ran twice a year, in April/May and September-December. By the end of 1986, nine groups were operating: eight of the original eleven groups - the Type-Rite, Spellbinder and Wang groups had stopped - and a new one - the Apple group had split into Zardax and Sandys' groups. At the end of 1987, eight groups were running, the Sandys' group having ceased to operate. The participation rate at this stage was still approximately one hundred out of an eligible 290 staff members.

In 1988 the number of groups running had shrunk to five: Word (MSDOS); Word (Macintosh); Word Perfect (separate groups for version 4.1 and 4.2); and Multimate. Over one hundred staff members attended the first round of meetings in 1988. These figures suggest an increasing standardisation of software and hardware packages in use at the University.

All groups lapsed at the end of 1988 because a reorganisation of the training and development functions of the University left them, temporarily, without administrative support. Two groups, MSWord (MSDOS) and Word Perfect recommenced activity early in 1990, supported by the new Professional Development Centre. They meet for an hour regularly each month. A third, for users of Word on Macintoshes, is planned to start later this year.

Lessons from the experience

The stark facts related above cloak a world of experience, from which a number of lessons may be drawn.

Range of concerns

The focus of the groups on specific software packages has, if anything, firmed up over the period of their existence. It will have been noted that the original Apple group eventually split into two, covering separate software packages. This package focus is essential when the group members are not enthusiasts, and consequently find little of interest in the problems facing the user of another package, even though it runs under the same operating system.

In their time the groups have addressed topics such as: incorrectly loaded print wheels; console and file merges; spell-checking; page numbering; conversion from/to other formats; controlling line and character spacing; printing on envelopes and labels; using columns; efficient word processing and office procedures; creating directories; managing a hard disk; ergonomics of work stations; and importing dBase files. Apart from these topics, which are drawn from the material circulated after the meetings, innumerable queries across a broad range have been addressed: everything from what proportional spacing is, to the features contained in new version of a package.

In short the range of concerns raised reinforces the rationale for the initial development of the groups themselves. Operators face a myriad of problems, few of which are addressed in formal training. If they are addressed, the skills are often lost and the information forgotten, by the time they are required in the workplace. As Brandt notes (in the context of library microcomputer user groups):

> *Why do librarians need user groups? For the same reason 'hobbyists' or anyone else does: microcomputers are complex tools, difficult to understand and use. (Brandt, 1987, p.29)*

The role of the facilitator

One of the key differences between the user groups described here and conventional groups, is that the University's groups are not, in the main, composed of enthusiasts, as just noted. Further, some steps have been taken to ensure that those with high level technical skills, or those with non professional involvements with word processing, have been excluded from the groups. This has been done primarily to avoid overwhelming members of the key target group — non professional operators of the packages — with the 'technical banter' mentioned by Kugelmass (1986, p.30) as both a boon and a problem with conventional groups. Rather than being enthusiasts, the staff involved in the groups are often more accurately described as phobics! As such they are sensitive not only to 'technical banter' from others, but also to the potential loss of dignity that raising what may be trivial concerns with a group of peers sometimes involves.

For these reasons the presence of an experienced facilitator from the Professional Development Centre is crucial to the success of the groups, at least in their formative meetings. The facilitator's role centres on group management.

General criteria for good learning centred groups have been set out by Fawcett Hill. He sees the following as essential characteristics:

1 *A warm, accepting, non threatening group atmosphere.*

2 *Learning is approached as a cooperative enterprise.*

3 *Learning is accepted as the raison d'etre of the group.*

4 *Everyone participates and interacts.*

5 *Leadership functions are distributed.*

6 *Group sessions and the learning task are enjoyable.*

7 *The material is adequately and efficiently covered.*

8 *Evaluation is accepted as an integral part of the group operation.*

9 *Members attend regularly and come prepared.*

(Fawcett Hill, 1977, p.40)

All of these are relevant to user groups set up as part of a staff development strategy. In consequence, the facilitator is responsible for setting up the group, ensuring the atmosphere is productive, ensuring comments, queries and suggestions are made sensitively and constructively, and for ensuring that the group functions as a supportive, learning centred gathering as much as possible. At times they must control the tendencies of 'experts' to lecture at length, at others they have to work hard to facilitate the participation of the less assertive members.

Development of autonomy

One danger is that the presence of the facilitator could lead to the group becoming dependent on this 'outsider' for its functioning. The danger is increased if the facilitator also performs or controls the administrative support provided for the group. This threat became a reality in the University's experience when the central support and facilitation was (temporarily) withdrawn, and the groups ceased to function, even though this was not a necessary consequence at all.

In principle it is desirable for each group to evolve towards an autonomy which would permit it to continue to function without administrative or facilitative support. Given the make-up of the groups however, and the organisational context in which they operate, this desirable end is most likely to remain a goal to be worked towards, and a principle to guide the activity of the group and the facilitator. Never-the-less it is important to seriously adopt this guiding principle and goal so that the group develops as high a level of autonomous function and independence as is realistically possible in its circumstances. The distribution of leadership functions advocated by Fawcett Hill above is one positive step which can be taken to encourage autonomy.

In practice what this means is taking steps to ensure that the responsibility for presenting demonstrations and for finding and communicating information concerning issues and problems raised is shared among the members of the group as much as possible. In this way the group will be experienced by its members as a mutual support mechanism, as opposed to a centrally run training activity. This perception will be reinforced, and the development of autonomy encouraged if the responsibility for facilitating the meetings, and for associated administrative work is shared among members, to the extent that this is feasible and reasonable given the risks, and the skills and workloads of those involved.

Control of diversionary concerns

One of the other differences with conventional user groups concerns the restrictions placed on the agenda of the group. In a conventional group made up largely of enthusiasts, the agenda is open, in that the group is almost certain to welcome most activities related to its purpose. Dealer demonstrations and sales drives, expert lectures, and excursions into esoteric features all have a place in the life of these groups. In groups set up for development and support purposes however, the make-up of the group, the relative absence of enthusiasts, and its work orientation, all combine to restrict the acceptable agenda. The above items, which have a legitimate role in a conventional user group, have the potential in a support group to jeopardise the continuing goodwill of the members, and the support of the overall organisation.

The difference between the two types of user groups is not always clear to the members of the developmental user groups, so that suggestions and spontaneous attempts to use the group for sales and technically oriented presentations need to be carefully monitored and considered. The overriding concern must remain with the work related needs of the group members themselves. Where the facilitator considers it necessary to argue against an activity, or to cut off an activity, s/he should do so by arguing the point tactfully and by referring to aspirations of the group and the elements of its context that lie behind the decision. No matter if the facilitator fails to win the group over to his/her point of view. The attempt and the discussion will have been valuable, and the subsequent activities more keenly considered by all. In this way the process of the group assists the group and its members towards refining their goals and developing their autonomy and independence.

Development of a support network

The names and phone numbers of all members of the groups are regularly made available to all members. It has been found that this encourages members to contact and support each other between meetings of the group. Thus minor problems are often sorted out as they arise, with only a report of the issue being made at the group meeting. The development of these contacts is encouraged, both as a support for the group and its developing autonomy, and as a support for staff who are otherwise relatively isolated.

Benefits for the overall staff development strategy

The presence of the user groups in the overall training strategy of the University has a number of benefits:

- The groups have become a contact point for an otherwise difficult to assemble group of staff. The experience of the members can be consulted for advice over the best way of proceeding with a computer training proposal which relates to them, or information on ergonomics can be presented and explained. At times issues to do with relations between staff and supervisors arise, as do workplace practices and ways of controlling workflows. These can often be dealt with in a natural and supportive way by the group, with difficult cases being taken up outside the formal group meetings.
- At the same time, the groups provide an opportunity for the facilitator to monitor computer training needs and to feed these back to the appropriate support groups for consideration. Thus when many work units decide to upgrade to a new version of software, this will become apparent in the user groups and appropriate training considered. This sort of current information is very difficult to obtain in any other way in a decentralised organisation.
- Beyond computer related needs, the close contact which the groups afford between the facilitator and the members, permits exchanges of information on a wide range of topics relating to almost any concern of mutual interest. The high profile that the training and development function attains in this way is invaluable for the dissemination of in-

formation, the development of contacts, and the raising of training issues among a group of staff not normally disposed to consider them on a broad scale.

Conclusion

The University has found the user groups I have described to be an effective way of continuing to support its wordprocessing operators beyond their initial package training. Provided the groups are well run, and their support function kept in clear focus, they allow the staff concerned to handle the issues computerisation raises in an easy and supportive atmosphere.

The provision of this timely practical support to operators has the potential to reduce stress levels among staff, while increasing productivity. These benefits alone make the inclusion of user groups within the overall training and development strategy of any organisation well worth considering.

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Microcomputer implementation in the primary school: The effect on teachers attitudes and perceptions

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Microcomputers have only been available for use in Western Australian school since the mid-seventies. Following the introduction of this technological innovation educational policies recommending practices on the use of computers in classrooms slowly developed (Education Department, WA 1980/81). In a relatively short time, therefore, as far as educational change is concerned, teachers were being expected to incorporate computers into the curriculum. (Anderson, 1984; Baume 1986.)

In Western Australia, funds were made available by the government to supply all its primary schools with one microcomputer for every 50 to 60 students. Few resources were allocated to support schools in the implementation process which, according to Dynan in Cox *et al* (1988) is one stage of the effective Innovation model — Inception (Government initiative), Resources (technology in classrooms), Adoption (school participation), Implementation and Outcomes (effects on learning). The Implementation Stage warrants closer examination to ascertain those factors which could influence classroom practice, the decision making and the management processes within the school environment.

Factors affecting implementation

A diversity of opinions and results is apparent when attempting to determine the nature of effective implementation (Meister, 1984). Teacher education and commitment, teacher attitudes, access issues, policy implications and curriculum integration are some of the acknowledged major contributors to successful implementation (Burdett, 1987; Hill *et al* 1988; Meister, 1984; Woodhouse and Jones, 1988).

Other factors which seem to affect implementation are teacher's attitudes towards the innovation and a wide range of behaviours. Particularly well known is their resistance to change, often attributable to difficulties in changing habits, fear and a sense of futility in attempting to adopt yet another new idea (Waldrop and Adams, 1988; Henson, 1987; Scanland and Slattery, 1983; Lidke, 1981). In addition, time for teachers to become familiar with the resources and to develop proficiency in their use, influence the effectiveness of the implementation process (Chandra et al, 1988; Cox et al, 1988; Strudler and Gall, 1988; Woodhouse and Jones, 1988).

Knowledge attitudes and perceptions

A number of recent studies highlight a variety of teacher characteristics which could influence the implementation and use of microcomputers. These include gender differences, teaching experience, age, computer anxiety, inservice computer training, general attitudes towards computers and perceptions about computers (Bracey, 1988; Cicchelli and Baecher, 1985; Fitzgerald et al, 1986; Meister, 1988; Shavelson et al, 1985).

As might be expected, computer anxiety decreased with classroom use/computer instruction (Ernest, 1986, Gressard and Loly, 1985). Some gender differences in teachers' perceptions of children's use of the computer were found by Fitzgerald *et al* (1986) in their study of Australian primary and secondary schools. The researchers reported that teachers considered the most desirable advantage of computers in the learning program to be the development of language skills and the least desirable to be the development of social skills. Insufficient computers caused the biggest problems, closely followed by lack of funds and specialist teachers.

Although various teacher characteristics have been examined by a number of researchers, few, if any, have focused on the primary classroom teacher. This study was designed to examine the characteristics of some primary teachers and so begin to provide an insight into this aspect of the implementation process.

The aims of the project are to:

1 describe and monitor teachers' classroom and computing experiences;

2 describe and monitor teachers' general attitudes and perceptions of computers;

3 describe and monitor teachers' perceptions of computers in education.

Methodology

A small local primary school which had no microcomputers prior to the government initiative, participated in this study as it had received its first two microcomputers in March, 1988. A longitudinal case study of different aspects of microcomputer implementation in this school was undertaken by a team of five researchers from the Western Australian College of Advanced Education. This paper relates to one section of this study, namely teacher characteristics.

Data collection was carried out through the use of a comprehensive questionnaire, two interviews with the principal of the school and a series of observations of the principal's computer use in the classroom. The questionnaire from the Fitzgerald Australian study (1986) was adopted and modified slightly to accommodate the primary classroom context. A five point Likert scale was used where the rating of 1 referred to strong disagreement of undesirability, while 5 rated as strong agreement or desirability. The final version of the questionnaire contained three major areas - background, general attitudes and perceptions and perception of computers in classrooms.

The questionnaires were administered in April, and again in December, 1988. The principal undertook to distribute them to the teachers and they were collected within two weeks upon completion.

Results

Background on teaching and computer use

All teachers were experienced and had been teaching from eleven to twenty-eight years. Two of the six teaching staff were males and held key positions in the school. These were the Principal and the Year 6/7 class teacher who was also considered to be the teacher with the most expertise in computing as he was currently studying for a Graduate Diploma in Computer Studies. None of the teachers had received any pre-service education in the use of computers.

During the period of the year long study a few hours of in-service training was undertaken by all teachers. Except for the Year 1 teacher, all teachers reported that they had used the computer in the classroom at least once a week or more.

General attitudes and perceptions

A summary table of results of this section of the questionnaire shows the means calculated for each teacher on the five sub-sets of items. (See Table 1.)

The responses to the subset on gender differences were the only group of items to show a polarisation of attitudes by all teachers over time. This may be due to the ease with which teachers could personally relate to their immediate experiences with the computer during the year. It is of some concern that the perceptions of all the female teachers and the male teachers were quite different in relation to computers being more interesting to male teachers. The female teachers had changed their responses to one of disagreement while the male teachers maintained their opinion of agreement with the statement.

All teachers, except one, remained almost unchanged in their strong desire "to learn a lot more about computers". The degree of anxiety about working with computers ranged from no concern to considerable concern and these feelings persisted even after a year of the school implementation program. A similar range of perceptions was maintained about computers costing "too much money for most people".

Table 1 Summary of results for five sub–sets of items

	use & effects in everyday life		usefulness for a job	
	Pre-intro	*Post-intro*	*Pre-intro*	*Post-intro*
Princip-al	3.8	3.8	4.75	5.00
Year 1	2.4	3.2	4.25	4.25
Year 2	2.6	2.4	3.50	3.25
Year 3/4	2.4	2.6	3.75	2.75
Year 4/5	3.0	2.4	3.25	3.50
Year 6/7	2.8	2.4	3.25	2.50
Total means	2.8	2.8	3.80	3.50

(continues over page)

	sexism		computers in classrooms	
	Pre-intro	*Post-intro*	*Pre-intro*	*Post-intro*
Princip-al	1.75	1.75	4.25	3.50
Year 1	2.50	1.00	4.00	4.25
Year 2	3.25	2.00	3.50	3.00
Year 3/4	1.50	1.00	3.75	4.00
Year 4/5	1.00	1.00	3.50	3.50
Year 6/7	1.75	1.75	3.50	3.75
Total means	2.00	1.40	3.80	3.70

	computer anxiety/alienation	
	Pre-intro	*Post-intro*
Principal	1.7	1.8
Year 1	3.4	2.4
Year 2	2.8	2.6
Year 3/4	1.7	1.6
Year 4/5	3.4	3.1
Year 6/7	2.1	2.0
Total means	2.8	2.3

Perceptions of computers in the classroom

The following tables summarise the means calculated from the item responses by each teacher, where statements were rated from "strongly undesirable" to "strongly desirable". Results were collated to produce rankings.

Like the results found in the Australian study of Fitzgerald *et al* (1986), teachers felt that computers were most advantageously used as an information source, for word processing and administrative tasks. Following the implementation period, however, teachers ranked higher some functions of the computer which could have the potential for reducing the time spent on tedious and repetitive tasks, namely, for administrative purposes, drill and practice activities and marking and analysing tests.

The most marked difference between the results for this section of the study and those obtained by Fitzgerald *et al* (1986), related to this use of the computer in special education. Teachers in this study actually lowered their ranking to one of undesirability of this use following the introduction of computers, while in the Australian study, teachers considered it to be a desirable use. It is possible that the teachers' perceptions in this case study were influenced by the very limited number and variety of software packages available to them. That is, the teachers' beliefs were not confirmed by the knowledge gained through their uses of the computer in the classroom.

Using computers "to develop social skills" drew the widest individual differences in responses in both questionnaires, although the means for this item from the pre and post introductory data were constant at 3.0.

Difficulties encountered by the teachers were evidenced by their strong agreement with the statements relating to insufficient funds for purchase of computers and not enough computers in classrooms. These appear to be among the long standing concern of teachers (Fitzgerald et al. 1986), although in the Australian study teachers ranked "insufficient funds" fifth in the list of major problems.

Following the implementation of computers in the school, the teachers expressed even greater concern about insufficient teachers with specialised training. As most were inexperienced in the use of computers, this finding suggests they considered the skills of a key resource person essential in this specific learning environment.

At first teachers did not feel there was a lack of high quality software, but following the introduction of computers into the school they felt this was a difficulty.

Uses of computers in classrooms

This last section of the questionnaire contained nine identical statements about seven different uses of the computer in the classroom. A brief example of each use was given to explain word processing, drill and practice, problem solving, managed instruction, games and simulation, tutorial and data bases. Teachers were not given any software to assist in their identification of the seven categories of uses.

Comments have been made about individual responses of teachers in relation to some statements across the seven categories of uses. In addition, means have been calculated for responses to Item 6 - "be a good use of computers in the classroom" - for each category (see Table 3).

Table 2: Main advantages of computers in classrooms

	Pre-intro		*Post-intro*	
	Rank	*Mean*	*Rank*	*Mean*
An information source (eg library support, data bases)	1	4.8	4	4.3
Language and writing skills through word processing	2	4.7	3	4.5
Administrative tasks (eg timetabling, records)	3	4.5	1	4.8
Developing learning & skills - simulation & educational games	3	4.5	3	4.5
Drill and practice	4	4.3	2	4.7
Diagnostic testing	4	4.3	4	4.3
Use in special education	5	4.2	7	3.5
Mark and analyse tests	6	4.0	3	4.5
Helping students with problems	7	3.5	6	3.8
Teaching programming	7	3.5	8	3.3
Helping students gain understanding	8	3.3	5	4.0
Reward for students	9	3.0	6	3.8
Develop social skills	9	3.0	9	3.0

Table 3: Difficulties with using computers in the classroom

	Pre-intro		Post-intro	
	Rank	Mean	Rank	Mean
Not enough computers available in classrooms	1	4.5	2	4.8
Insufficient funds available for purchase of equipment	2	4.3	1	5.0
Little known about how children learn when using computers	3	4.2	3	4.3
Teachers will have to give up important preparation time to become familiar with computers	3	4.2	4	4.2
Not enough teachers with both teacher & specialised training — key resource people	4	3.8	2	4.8
Lack of suitable in-service courses for teachers	4	3.8	6	3.5

"be more useful for boys than girls"

pre mean = 1.3; post mean = 1.3

All teachers strongly disagreed with this statement for almost every use except the Year 2 female teacher, who was either undecided or expressed disagreement. The two male teachers and the Year 4/5 female teacher changed their views on one type of activity each, while every other response from the remaining teachers did not change.

From showing no bias at first the principal agreed word processing would be more useful for boys. Perhaps he felt this skill would be necessary in the work environment of the near future particularly for males who were not expected traditionally to use typing as part of their job.

The Year 6/7 teacher had been unsure about games and simulations being more useful for boys than girls but finally strongly disagreed with the statement. He could have found in practice that girls were equally enthused by this type of computer use.

The Year 4/5 female teacher selected the midpoint as her final response about drill and practice being more useful for boys than girls. This rating choice was made in response to the majority of

items on use of computers in classrooms. Her once a week use of the computer may have been insufficient experience upon which to base a more definitive decision about the degree of computer usefulness for these types of activities.

"scare and worry students"

pre mean = 1.8; post mean = 1.4

Two of the female teachers (Year 2 and Year 3/4) were either undecided or disagreed with this statement for each given example. This was in contrast with the other teachers who were mostly consistent in their strong disagreement that "the computer would scare and worry students". These same two female teachers also indicated the most anxiety/alienation towards the computer in their post introduction responses about general attitudes and perceptions (see Table 1). It appeared their views about student anxiety were a reflection of their own feelings towards the computer. In general, however, teachers' perceptions of student anxiety decreased correspondingly to their diminution of alienation/anxiety feelings.

"be a good use of computers in a classroom"

pre mean = 3.9; post mean = 4.1

All seven categories, as explained in the examples, were viewed favourably by the teachers (see Table 4), with drill and practice uses (mean = 3.7) at the lower end of this favourable scale and problem solving (mean = 4.5) seen as the best use of computers in a classroom.

In comparing these results with those of similar items in the section on "Main Advantages of Computers in Classrooms" (see Table 2), collated rankings corresponded quite closely. The one exception was on drill and practice where the example (ranking = 2, mean = 4.7) and the item (ranking = 5, mean = 3.7) differed considerably.

Perhaps this relates to the position from which the teacher views the use. The example could have been quite clearly associated with beliefs about good teaching practice, as the statement about "good use" was preceded by an example outlining a teaching/learning situation which may no longer be widely advocated. On the other hand, the item on drill and practice, which was placed in the general section on "advantages" of computers, may have been primarily considered as an aid for the teacher because of the context in which it was read.

It could be argued that all examples and items may be perceived in this way. But drill and practice is the only application of the seven given, which would appear to possess questionable educational value. That is, when teachers considered mainly the quality of a suitable learning environment, they did not rate drill practice as good a use as other applications.

Table 4: Different uses of the computer in the classroom

	"good use of computers"			
	Pre-intro		*Post-intro*	
	Rank	*Mean*	*Rank*	*Mean*
Word processing	2	4.7	3	4.2
Drill and practice	5	3.8	5	3.7
Problem solving	3	4.3	1	4.5
Managed instruction	4	4.0	2	4.3
Games and simulation	1	4.4	2	4.3
Tutorial	5	3.8	2	4.3
Data bases	2	4.1	4	4.0

Discussion

There is no doubt that the introduction of computers into primary schools can present problems when teachers are faced with the implementation of many policy and syllabus recommendations about computer use (Commonwealth Schools Commission, 1986; Ministry of Education 1989). From the teacher's viewpoint these recommendations appear to imply that the curriculum will be enhanced by using computers in the educational programme. Consequently there is pressure to adopt such recommendations as classroom practice. This cannot be achieved without change. Change may have many faces and be influenced by many factors, some of which have been described in this paper.

Among the group of teachers in this study, relatively few or major changes were found in their perceptions of computers and their use in the classroom. Although these findings cannot be transported to other primary environments, some interesting questions emerge about aspects of change in the context of computers in education and curriculum expectations.

Floden and Huberman (1988) suggest that educational improvement, which assumes change of some form, relies on teachers, who must maintain their commitment to their chosen program over a long period of time. According to Guskey in Floden and Huberman (1988), it is only when teachers have clear evidence of the effects and results of the changes on children, that they will continue to pursue such a course. This has implications for technological implementation, if factors influencing success are teacher perseverance over prolonged periods of time and the perceived effects of the changes on children.

Although age appeared not to affect computer use (McCoy and Haggard, 1989), it could perhaps be related to rate of change. Huberman (1988) found in his research on teachers' professional life cycles that teachers with about ten to twenty years teaching experience (the same range as most teachers in this study) were at a stage in their career when many were reluctant to try new ideas. Could this not have an impact on their willingness to accommodate such a major change in their environment as the introduction of computers? In view of the fact that fewer younger teachers are being trained and employed, this innovation could continue to pose significant problems with the majority of teachers currently having more than ten years of experience. Investigations in this area are warranted.

Further considerations in overcoming the changes which are needed in classrooms to facilitate confident and expert computer use by teachers are sound planning, a relevant policy and a set of goals for a specific school population. A collaborative approach is essential and this requires the use of effective communication skills and strategies by all school staff (Snyder, 1988)

Perhaps some of the problems of lack of knowledge about the use of computers by school colleagues and inadequate consultancy could be overcome by the mutual sharing of information and techniques. It would be interesting to explore, for example, a team teaching approach, where a reluctant teacher and an experienced teacher combined classes to trial, practice and observe a range of strategies.

Gender differences were still apparent at the conclusion of this study and the findings support many of the aspects described by Fitzgerald *et al* (1986). The maintenance of the two male teachers' opinions that computers were more interesting to male teachers is of particular interest. Fitzgerald *et al* (1986) found in their Australian study that there were more male co-ordinators than female coordinators. While having a computing coordinator may not necessarily be the best approach to adopt in a primary school, the ways in which females are involved in the school computing environment could be vital in any attempts to dispel apparent gender differences.

Specific strategies may need to be undertaken by principals to ensure female teachers are involved in making decisions about policy development, computer access and curriculum integration. Differences in perceptions of gender differences may be overcome by encouraging female and male teachers to become resource persons rather than coordinators. An adoption and analysis of this model could provide further data on this issue.

Based on sound educational theory and practice, successful integration of computer use into the curriculum may be influenced by the learning and instructional styles of the teachers. It would seem feasible to suggest that a range of effective educational strategies already exists in the teacher's instructional style. How this repertoire of skills could be incorporated into successful computer use without greatly changing the teacher's chosen style is the question.

This study has provided a valuable insight into some teachers' perceptions of computers in education. It has spawned a number of useful ideas for further research into computer use in primary schools. We need to know a great deal more about the characteristics of change in relation to age, the role of female teachers in the adoption of new educational practices and teachers' learning and instructional styles.

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The convergence of teaching and production in media centres

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New and amalgamated universities are facing decisions about how best to provide audio visual services for teaching and research. This paper will outline research that the author conducted concerning centres in NSW and Victoria as part of the development of proposals for a media centre for the University of Western Sydney, Nepean. The role of professional production services was one of the key issues that emerged in the research which has implications for buildings and facilities and staffing. The production function by specialists has been traditionally separated from the loan/teaching service for students. Is it desirable or possible for these functions to "converge"?

The issues are not unique to Nepean as questions of facilities, technologies and administration are relevant to all institutions. Multi–campus developments, distance education, videodiscs, teleconferencing and computer network links, all force the management of universities and colleges to make policy decisions about future directions of resources. The narrowing of the difference between broadcast–standard and domestic–standard video, for example, has led to an expansion of the use of video by students (and staff) with little training in production skills. The apparent simplicity of the technology may hide the skills needed to actually get the best value from it.

Universities have accepted the need for high quality video promotion packages to sell particular courses to students in Australia and overseas. When it comes to production of these, VHS productions by students are not adequate, commercial production houses are often prohibitively expensive. It's more appropriate for an internal production service to provide this kind of service. The same applies to professional still photography, desktop publishing, and the production of high quality graphics. The demand for these technologies has the potential to make media centres more central to the institutions teaching and research program. Thomas Russell from North Carolina State University in USA believes media centres can have a bright future.

> *Media centres will not only survive, but thrive now and in the future if we make the necessary changes to place our media centres right where they belong: at a critical place in the centre of the parent system (Russell, 1988, 158).*

There may be some need for thought of the management of technology in these centres. Television, for example, has become an integral part of the educational resources in most higher education institutions. Television production was undertaken by staff in media centres to produce resources for 53 out of 58 tertiary institutions surveyed in

1987. (Neale, 1987) The extent to which that production is conducted by specialist staff is part of the more general question of media centres as providers of equipment versus media centres as producers of resources.

The term "media centre" is used here to encompass those facilities and departments that physically house audio visual equipment and manage its use. This paper focuses especially on those centres that the author has been able to visit in Victoria and NSW as part of his own submissions for resources at Nepean. In 1986 the University of Western Sydney, Nepean commenced a three year BA(Applied Communication Studies). The existing "media centre" was a small section of the library which mainly lent 35mm cameras, projectors, cassette recorders and a limited number of domestic video camcorders. An adjacent space designated as a television studio had no working studio equipment, no lights nor sound system and was being used as a classroom. Demand for equipment increased rapidly during 1987 with practical production courses including a Media Production Specialisation, Design, Dance, Visual Arts and Photography courses introduced or updated

As Nepean has no "specialist" production facilities, I was interested in the role of production services within institutions. An important question was whether production services with specialist staff could co-exist with facilities designed for student use?

Financial constraints

It would appear logical that convergence of the loan and production service functions of centres would be driven by financial restraints imposed on centres.

A study conducted in 1986 aimed to set a bench mark on the state of media centres in Australian CAE's. The scenario found by the 1986 study was not encouraging.

> *Funding cuts, rising costs, static or reduced staff profiles, aging equipment either past its replacement date or rapidly approaching obsolescence, increased demands for the provision of training albeit with old equipment in insufficient quantities, providing services to multi-campus institutions and providing additional services to new nursing students and staff. (Norman, 1988, 66)*

Many of the CAE's surveyed in the 1986 study have now become part of larger universities where the issues identified will no doubt become more pressing.

Despite the financial pressures I found evidence that the majority of centres maintained a clear separation of those resources for "professional" production and those for teaching. Even those centres that appeared to have a sharing of resources between students and professional production personnel only allowed a very small number of well trained students to operate equipment.

Present divergent models

The specialisation within institutions of units for teaching and units for production was evidence of the perceived need to separate these functions. With a few exceptions, the media centres were either predominantly a centre for students or primarily a production service. Media centres were a hybrid of a number of different functions. These included a loan function for equipment for staff and students; on-campus production facilities for student and staff use ; professional production facilities for developing material for use in teaching or research. Each higher education institution had a different way of dealing with these functions. Swinburne Institute of Technology was the most diverse with two separate Faculty audio-visual services and an Information Technology Centre. Royal Melbourne Institute of Technology had diverse solutions with broadcast quality television studios for production of professional quality resources, a Faculty radio station with five studios and an "electronic classroom" which allowed teleconferencing with a group of 15-25 students in the room. Despite the hybrid nature of centres they could still be classified into two categories according to their orientation to students or their orientation towards producing resources *for* teaching and learning. (This was the situation in January 1989 and may have changed since then with further amalgamations and reorganisations of universities and colleges).

Media centres for students

These facilities had been set up to allow students access to equipment as part of their course work. Their predominant function then was a loan service. Some were staffed and resourced by a specific faculty within the college or university while others were part of the Library. Most had very small teams with typically one or two technicians and loan staff. They had staff to provide very basic instruction to students on how to operate equipment. Some of these centres combined the function of providing audio visual support services to the whole institution with the training of students.

The units that seemed to fit this description included:

Faculty of Arts/Swinburne

Faculty of Humanities and Social Sciences/University of Technology, Sydney

Instructional Technology Unit/ Victoria College, Toorak

School of English and Linguistics /Macquarie University

Audio visual service/ Melbourne CAE (now Melbourne University) Audio Visual Service/University of Western Sydney, Nepean.

Audio visual unit /University of Western Sydney, Richmond.

North Sydney Technical College

The loan function of centres

The management of the loan of book and non-book resources has typically been the responsibility of a library. However, as the technology being used by students and staff becomes more complex the skills required of staff lending equipment becomes more specialised and includes the ability to teach how to operate equipment and identify and solve problems with equipment. Industrial disputes have developed at several media centres about where the responsibilities of technical, academic and production staff begins and ends. What seems clear is that Libraries with their book orientation do not easily incorporate media centres with noisy and complex equipment including video editing, computer and television studio equipment. Of all the centres I have visited in NSW and Victoria only two were within a Library. The unit at what was Melbourne CAE was under review. Another at what was Hawkesbury College of Advanced Education(now UWS, Richmond) was physically isolated from the rest of the library.

The equipment loan function was still a part of the responsibility of media centre staff, but was handled differently from centre to centre. It was considered by most media centre managers as a time consuming and somewhat unproductive role. They had tried to streamline it as much as possible. One unit (Information Technology Services Unit Swinburne) had stopped providing a loan service to students because it was considered to be too labour intensive.

Student use in coursework.

The units within Faculties had the least ambiguous role. They knew who their clients were and were well organised because of the known demands on resources and equipment that were tied to specific courses. The role of faculty centres was primarily to provide facilities for students to complete coursework using video or audio equipment. In some Faculties the word processing equipment also came under the media centre (University of Technology Sydney, Swinburne Faculty of Arts). These faculty units have high student usage rates with technical staff typically providing support for students outside class time. Professional production was not seen as possible because most of the equipment in these units was domestic and was used extensively for teaching. Phillip Institute was the only college I have seen where student use and professional production are combined successfully. This is achieved by having off-limits equipment within the unit that a few students operate only after intensive training courses. This requires a disciplined and very well organised management which can enforce such policies. In these days of class sizes of twenty in many Communication courses, one to one specialist tuition is becoming more and more difficult. It would be irresponsible to allow untrained student operators access to very expensive and complex equipment.

Media centres for production

These units combine support for academic staff for resources (but not usually students) with the production of high quality video, photographic, graphic and audio resources. Most had a small television studio for use by professional staff and employed graphic artists and photographers.

Teaching Services Unit/ Victoria College, Burwood

Communication Services Unit/RMIT

Audio Visual Unit/Melbourne University

Education Unit/ Chisholm Institute

Audiovisual Services Information Resources Centre/Macarthur Institute(now UWS)

Sydney University Television Service/ Sydney University

Production Services /UTS (Kuring-gai)

Media and Production services Unit/Phillip Institute of Technology

The larger Universities and Institutes of Technology had professional production services. Melbourne University employed sixteen specialist staff in production including a television producer, chief technical officer, three graphic designers and a full-time stills photographer. Typical services provided were photography, black and white printing, computer graphics, graphic design and desktop publishing, and the production of videos for publicity, teaching and research. Video production has become more sophisticated, with several units completing production work for outside organisations. There is a recognition that resources need to have a "broadcast quality" look to compete with other video material that is on the market and to have the professional "look" that student and staff have come to expect. There are some marketing success stories from these media centres. A video on bushfires by Production Services of Melbourne University gained an International Television Association award and has achieved impressive sales.

The emphasis is on portable professional quality video equipment and broadcast quality post-production facilities.

There is an increasing specialisation of professional staff required to complete work such as computer graphics, video editing and production. Freelance staff are being engaged in some institutions on a program by program basis. The production services within universities are better equipped to mesh into telecommunication links than the "low technology" teaching centres.

The obvious need to develop links within and between campuses has been led by technological developments which allow the delivery of existing materials (Television programs, audio and OHP material) via satellite. These developments have been prompted by commercial and community groups using satellite facilities which has prompted the interest of higher education staff. In NSW the State teachers union have made extensive use of SKY Channel to broadcast meetings live around the State. In the commercial sector an Australia wide educational network has been developed by IBM for its own training needs. It consists of a transmission studio in Sydney from which two pictures and the teachers voice are transmitted via satellite around Australia to eleven classrooms in the six mainland capital cities. Students at all locations can ask the teacher questions and talk to other classrooms on the network. IBM have introduced the system to increase the productivity of their staff by deleting unnecessary travel and duplication of courses around Australia. (ED TECH NEWS, 1989).

The IBM ISEN development is less production oriented than traditional media centre models. These developments have implications for media centres. If they are part of national networks then questions of equipment compatibility and standards have to be considered.

There may indeed need to be some reorientation of media centres in the way they use resources, as the ISEN network shows. However, I still believe there are specialist functions which need to undertaken with these changes to technology. Teachers will need to be trained in some of the techniques of on-air television presentation. There are high capital costs in establishing such facilities and they require specialist staff to maintain them.

To converge or not?

The investigation of media centres in NSW and Victoria, although by no means exhaustive, has led to some practical suggestions for plans for facilities at the University of Western Sydney, Nepean. The detail is not relevant to this paper but areas covered include the location of the centre, staffing, relationship to the library, teleconferencing and other telecommunication systems. There are management and University wide issues that are yet to be resolved.

I found evidence that the professional services offered by media centres may need to change. Computer technologies, photography, graphics, video digital post production and desktop publishing provide new opportunities for centres. Rather than there being a diminishing of skills required the new centre may need to employ more specialised professionals. The advent of cheaper technologies can provide opportunities for student use. But such use still needs to be properly managed.

These issues are also relevant to older Universities who now find themselves with a number of former colleges with different levels of equipment, staff and facilities. These amalgamations provide the opportunity for there to be a central production unit which can produce the high quality resources needed by education.

Media centre developments have the potential to be central to the rationalisation of video, audio, radio, teleconferencing, computers and other digital technologies. The greater accessibility of desktop publishing and VHS video editing can lead to a do-it-yourself mentality that underrates the services that can be provided by more professional media production services.

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Developing guided self-study materials for higher education: The Curtin experience

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In an age of accelerating technological change where today's knowledge and skills are obsolete tomorrow, it has become imperative to maintain a continuous process of inquiry and learning to update present expertise. It is thus not enough for our educational systems, from primary through to tertiary, to simply produce 'knowledgeable' people, we must produce people who are equipped with the skills and attitudes to continue the process of learning throughout their lives; we have to produce life-long, autonomous learners.

Curtin University was one of the earliest Higher Educational institutions in Australia to express significant interest in independent learning. In the mid 1970s money and time were made available for staff training and the development of materials. Schools and Departments set up whole courses, or parts of courses, in the independent study mode for students on campus. Some of these courses are still running successfully now, others were discontinued, mainly because of the time it took to develop and update the materials. All of this took place before the technology was available which can now make the task of developing and updating independent learning materials less onerous.

The availability of relatively cheap, sophisticated technology, the reduction in financial resources for teaching, the current, and I hope lasting, trend towards the promotion of autonomous learning and the dissatisfaction with 'chalk and talk' as the sole method of instruction has led to a resurgence of interest in developing more independent learning materials for use by on-campus students at Curtin University.

Guided self-study is a form of independent study for which there are a whole host of names, each having a slightly different emphasis, but having much in common with guided self-study. You may be familiar with the following names:

Directed Private Study
Individualised Learning
Supported Self Study
Programmed Instruction
Packaged Learning
Correspondence Education
Distance Education
Learning by Appointment
Open Learning
Learning by Contract
Keller Plan
Personalised Systems of Instruction (PSI)
Flexistudy
Home Study
Computer-Based Training
Postlethwaite Audio Tutorial System

As I see it guided self-study is an early step on the continuum towards producing fully autonomous learners. Yet, depending on the emphasis, it can still be considered a teacher-centred approach — hence 'guided'. It is a mode of study which, because it doesn't have to lean too much towards learner autonomy, is relatively non threatening to the more conservative staff and institutions who are reluctant to release the reins. It is thus a 'softly, softly', diplomatic shift in the direction of developing independent learners. It is a way of beginning to promote self-directed learning in traditional institutions.

Aim

The aim of this presentation is to look at guided self-study as a step towards fostering self-directed learners with reference to developments in this area at Curtin University in Western Australia.

Organisation

The paper is divided into 3 sections:

1. The Advantage of Using Guided Self-Study to Complement the More Conventional Chalk and Talk Method of Teaching. In this section I shall cover areas such as:

- the reasons for increased interest in the guided self-study mode in Curtin and in Australian higher education institutions in general
- some reasons for the reluctance to introduce this mode of instruction
- ways of encouraging more teaching staff to develop and use guided self study materials

This section is based on issues raised in a recent seminar in Curtin on developing guided self-study materials.

2. Sections of Courses which Adapt Well to Guided Self-Study Mode. In this section I shall cover areas such as:

- Introductory modules
- Duplicated or often repeated lectures
- Service teaching
- Laboratory work

3. Technology Being Used at Curtin University for Guided Self-Study Programs. In this section I shall look at:

- Desk top publishing and computer graphics
- Computer managed learning
- Video
- Interactive video

The advantages of using guided self-study to complement the more conventional chalk and talk method of teaching

The advantages of using the guided self-study mode are made apparent when we look at the obvious disadvantages inherent in the lecture-based method of instruction. The lecture is of course valuable but it should not be used as the sole source of learning, for the following reasons:

- The speed at which information is delivered does not necessarily match the speed at which students absorb the information.
- The lecture is a 'once only' experience. If a point is missed, or not fully understood, it is not possible

to 'rewind' the lecture and listen again.

- Lectures do not allow for inter-student discussion or for student exploration of the subjects being taught.
- Lectures do not demand a particularly active role of students, apart from their bodily presence; their minds may be elsewhere.
- It is sometimes quite difficult to control the behaviour of large groups of restless, poorly motivated students.
- The value of lectures depends on so many variables: the inherent interest of the subject being explored, the amount of lecturer, and student preparation, the mood of the lecturer, and that of each individual student, at the time of the lecture, and so on. If one or two of these variables are not quite right, the value of the 'once only' lecture can be lost.

In a recent seminar at Curtin on developing guided self-study materials lecturers currently involved in using such materials as part of their courses, agreed that the following were the main pedagogic advantages of using this mode of instruction:

- Students can control the rate at which they learn. Some students obviously require more time than others. They can stop, rewind and start the audio cassette or video again, they can re-do computer tasks, they can re-read printed information as often as they require to ensure complete understanding of each section of the materials before proceeding to the next unit of study.
- Students can decide when, how much and in some cases, where to study; audio and video cassettes, computer and print-based material are all easily portable.
- In most cases students can choose to work through units on their own or with partners, or in groups should they need to or be required to explore various points through discussion and debate.
- Students following a guided self-study program are required to do far more than sit back and listen. They are expected to follow instructions, use different media, complete worksheets, analyse data, evaluate material and more. Students are therefore required to take a very active role in their learning.
- Good quality guided self-study materials are often packaged in modules complete with learning tasks, and self evaluation tests with answers. Students are thus free to attempt the tasks and tests and make mistakes in privacy so avoiding all the learning complications arising from making errors in public.

It was generally agreed by the speakers at the seminar, all of whom are lecturers running guided self-study programs at Curtin that:

- Students' performance improved significantly, both in terms of course work and end-of-unit test results.
- Motivation increased. Students actually reported enjoying the greater flexibility the materials allowed them and the opportunity to take greater responsibility for their own learning.
- Students' working relationships with lecturers and with other students improved.

The above advantages of using guided self-study materials relate directly to the students using them, with lecturers being the indirect beneficiaries, but what are the specific advantages for lecturers who invest time in developing guided self-study materials? The following were discussed in the seminar:

- Lecturers, freed from the tyranny of delivering lectures, can devote more quality time to counselling and tutoring individual students and to assessing student work — thus experiencing more professional satisfaction.
- Reduced lecturing time can enable lecturers to concentrate on their own research and development.

Other, more general advantages of guided self-study that came up in the seminar were:

- Funded self-study learning packages can be easily, quickly and cheaply adapted to or from the external studies mode.
- The materials can be sold to a DEC or to students on overseas courses.
- Quality learning materials enhance the reputation of the University and its staff.

So, given all these advantages and the very positive feedback from lecturers currently involved in guided self-study programs why is there reluctance on the part of the majority of staff to use the guided self-study mode?

The following reasons were expressed in the seminar:

- The perception of the time and costs of developing and updating guided self-study materials.
- There is little or no incentive to invest time and effort in developing quality teaching and learning materials since there is minimal linkage between this and promotion. Universities in particular like to be seen to be involved in research and development so that being engaged in research and the publication of articles has more value than producing quality teaching and learning materials.
- There is a fear of losing jobs as a direct result of producing self-study materials, particularly in the current climate of cost cutting and the redefinition of tenure combined with the administrative interpretation of 'reduced lecture time'.
- Not enough training is available to help higher education staff to redefine their roles from transmitters and controllers of instruction to that of facilitators, resource persons and counsellors for self-directed students.
- Lack of appropriate training leads to:
  - feelings of inadequacy in terms of how to go about designing guided self-study materials
  - feelings of inadequacy in terms of their abilities to act as facilitators, resource persons and counsellors
  - fear of losing control over their students
  - concern that their students won't be able to work on their own, thus leading to higher failure rates which in turn reflect on the lecturers
  - fear of peer criticism

- fear of not meeting the traditional student expectations of lectures and hours of lecturer/student contact time

- some lecturers expressed anxiety over using technology believing it to be expensive and unreliable. What happens to the student and to the course when the computers, tape recorders and/or video playbacks etc. break down?

How then can we encourage a change of attitude towards the implementation of guided self-study and more independent learning modes?

- I feel that it is imperative that staff currently involved in running successful guided self-study and independent learning units should vigourously promote their work through research, publishing articles, running seminars and workshops and displaying their materials. Management and colleagues need constant exposure to the benefits of running such programs.

  At the Curtin seminar on developing guided self-study materials several of the worries covered above were allayed by guest speakers who described their process through materials development, giving the following advice on time and costs:

  - Start small, don't be too ambitious. It is perfectly feasible to develop one module at a time rather than attempt to transfer a whole semester program at once into guided self-study material.

  - One lecturer explained that he simply compiled all his lecture notes into workbooks complete with information, text references for further reading, learning tasks, answers and essay suggestions. This didn't take up too much time and it didn't cost a lot either, but it allowed his students greater freedom and gave him more time to deal with individuals.

  - Another lecturer said he was forced to develop self-study materials when he had to attend a 2 week conference during a semester. He simply asked the Educational Media Centre to videorecord two of his lectures and made up a series of worksheets into a workbook to go with the videos. Copies of the videos and the workbooks were made available to his students and it worked perfectly. This small package is now the beginning of another guided self-study program. This experience made the lecturer aware of how different media can be used to 'spice up' his lecture-based course and it allowed him to be much more flexible in his approach to teaching and learning.

  - Other lecturers said that the initial development of the materials did consume a great deal of time, but once the courses were up and running they found that refining and updating the materials did not take long and they were free to devote more quality time to students and to research. In terms of cost the general feeling seemed to be that videos and print-based materials can be produced relatively cheaply using in-house university services.

- Management has to be prepared to support staff in the development of guided self-study materials by providing finance and releasing staff from some of their duties, or otherwise giving staff incentives to attend training sessions and develop materials.

- Management has to be helped to recognise the value of developing quality teaching and learning materials so that promotion is more closely linked to it.
- Ongoing training programs should be made available through which staff are:
  - exposed to a program of self-directed learning themselves
  - exposed to materials which have been proven successful, taken from higher education institutions over a range of subjects
  - encouraged to see, understand and accept their role of helping students to become autonomous learners without constant teacher presence and intervention
  - helped in the transfer of lecture-based units or modules into guided self-study materials
  - given the opportunity to work together with colleagues as a team in the transfer of materials to guided self-study mode
- Staff should have access to personnel who are experienced in the design of such materials i.e. Instructional Designers.

Sections of taught courses which adapt well to guided self-study mode

Introductory Modules

In many units, the introductory lectures may:

- cover areas of knowledge the students should already be familiar with or
- assume incorrectly that all the students are at the same level of 'learner readiness'

Instead of introductory lectures, students could be given guided self-study modules comprising readings, references, and activities planned around objectives which have to be achieved by all students, working at their own pace, but within a period of, for example, three weeks. Students are then free to choose where they begin. Some may decide to cover all the modules, others, who are familiar with the content of some modules, will discard those and concentrate on modules with which they are not familiar. A self-evaluation test, or a more formal test can be administered either after completing the modules, in the case of self-evaluation, or at the end of the third week in the case of a more formal test. Having mastered the content and activities within the modules all the students would be at an equal level of competency and be orientated towards the ensuing course of core, as opposed to introductory, lectures.

Duplicated or Often Repeated Lectures

Certain lectures are common to a number of units. Lecturers often have to give the same information to different classes. Repeating the same lecture can be tedious and the tedium is probably sensed and reciprocated by the students. Unnecessary duplication of lectures also has cost implications.

Duplicated or often repeated lectures are easily transferred to self-study mode; for example, by the production of print-based workbooks or by a package of video and worksheets.

Service Teaching

Certain subjects, for example statistics, are taught in more than one school or department. To avoid continually re-inventing the wheel it would save schools and departments time and money to transfer shared subjects to the self-study mode.

Laboratory Work

Ensuring that students have mastered relevant theory before embarking on laboratory work may mean that laboratories and workshops remain unused for weeks.

Once all the students have been through a course of theory lectures there is suddenly a difficult period of timetabling 100 or more students into laboratories and workshops to do the practical work. In some subject areas so many students need access to labs and workshop facilities that it is necessary to extend access hours and sometimes have students working unsupervised.

These logistical problems can be overcome by developing guided self-study manuals embracing theory and instruction related to laboratory and workshop assignments. Students may work to a prescribed order or one which suits them. The point being that not all students will need access to labs and workshops at the same time. Thus reducing timetabling problems.

Technology being used at Curtin University for guided self-study programs

The following technologies are being used or will be implemented to complement or replace the lecture-based mode of instruction at Curtin

Desktop Publishing and Computer-Graphics

All teaching divisions at Curtin use DTP and computer graphics to produce their teaching materials. In fact print is still the medium used for over 95% of all guided self-study and project based materials produced on campus. This is so for the following reasons:

- it's flexible
- it's easy to produce, update and change
- using word processors, it's relatively cheap to produce, duplicate and disseminate

With the advent of desktop publishing capabilities, it is now possible to include graphics, photos and illustrations thus making lecturer produced material look similar to professionally published texts.

The potential of this technology for education is enormous. Since all the data is on computer, it is now possible to produce either whole units as guided self-study packages, or divide the units into individually packaged modules, each complete with their own learning objectives, text information, learning tasks and self-evaluation tests with answers etc. These could then be interchanged with modules from other units thus giving students a far greater range of options than ever before from which to build up courses more closely suited to their individual needs and goals. Obviously, this flexibility would not be possible within an institution offering only lecture-based courses.

Computer Managed Learning

This has been tried and proven successful in our School of Nursing and Department of Human Biology where 1,100 students are using the CML program. I'll just describe how it is being used for one program in the School of Nursing.

The program was developed specifically for nurses who are returning to the profession after five years and thus need to re-register. 100 students are currently following the nursing re-registration course. Instead of requiring all 100 to come from all over Western Australia to attend a series of formal lectures at Curtin, the course comes to them. Students access computers through local learning centres stategically placed in the major cities or towns of the geographical regions of the State.

The program is made up of 22 discrete print-based topics. Each topic has a set of learning objectives and contains information-type material and clear instructions to guide students through the instructional module. All 22 topics must be completed successfully before students are allowed to progress to the clinical stage of the nursing course.

Students can randomly select topics to study although progression from one topic to another is entirely controlled by computer-testing. Tests precede and follow each topic. If students achieve 80% in the pre-test, they are not required to study that topic and can choose another at their level of knowledge. Students must also achieve 80% in the test which follows each topic before going on to another one. On completion of the end-of-topic test the computer provides the student with a list of areas which need more work, plus references for further reading for revision; an individual attention which is often not possible within a lecture-based program where the teacher/learner ratio is often 50-1 or more.

All test items taken and test results are recorded and stored by the computer so that students and course controllers can monitor progress.

Video

The use of video for guided self-study is becoming increasingly popular at Curtin. Videos are relatively easy and cheap to produce and allow students a greater amount of flexibility in terms of 'when', 'where' and to some extent 'how' they study.

The Educational Media Centre at Curtin has recently produced a short video course in learning skills to replace a series of learning skills lectures. The course is aimed particularly at non-native English speaking overseas students coming into Curtin. There are ten videos in the course, each packaged with a set of notes and learner tasks for users to complete. The advantages of such a program over a series of lectures for overseas students are obvious. They can play and re-play the videos to ensure complete understanding and they can make mistakes in privacy: an important factor in all independent learning materials — and particularly important for Asian students.

The Educational Media Centre at Curtin has also produced a major new video course in Microbiology — a key unit in the degree offered by the School of Nursing. The series will be available for the second semester this year. It comprises 18 topic-based video lectures and ten laboratory demonstrations. The videos are accompanied by a study manual and practical workbook which will allow students to work through the unit requirements at their own pace. The workbook includes tests and answers, so that students can evaluate their own progress through the topics. At present a conventional 2 hour end-of-unit written exam is offered. The unit is wrapped around a published text which all students are required to purchase.

The intention, after trialling the material, is to divide the unit into discrete modules and adapt the program for CML.

The Unit is being offered to 'off-campus' external and country contracted students. In order to reach external students dotted across the whole of WA, 28 videos will be broadcast on the local GWN EdTV Network. Students will be informed when these programs are to be aired and back up copies of each video will be held in the regional colleges as well as in the main Curtin Library External Editions Reserve.

Interactive Video

There are two ongoing interactive video projects in which Curtin is involved:

- The Surrogate Laboratory.
- The Japanese Interactive Video.

These projects are still in the very early stages of development, but are expected to be ready for use at the end of 1991.

The Surrogate Laboratory

DEET has funded the School of Electrical and Computer Engineering with assistance from the Eductional Media Centre to develop the surrogate laboratory interactive video for on-campus students and for the WADEC distance learning program.

The displays and controls of various technical equipment are stored on video disc and are made available for adjustment by the student through the computer controlled interactive video. The displays and controls are easily integrated with graphics and textual teaching material. Students are thus enabled to operate as well as to see and be informed about the equipment.

Educational audit software will be integrated into the package. This will provide the student with immediate feedback on progress and will provide the educator with longer term statistical and progressional information.

Access for the student is via a computer-controlled video disc, thus eliminating the need, in many cases, to provide the full range of training equipment in the early stages of the learning process. Considerable capital and maintainance cost savings are made. In addition, students only gain access to delicate equipment when competent to operate it, having undergone basic training via interactive videodisc.

Not only can interactive video improve teaching methods and the presentation of educational material, but it can also be used to minimise problems associated with teaching in remote locations and the lack of availability and access to extremely expensive equipment. Where the student population is remote from an educational institution, or where the student population is widely distributed, it is uneconomic as well as physically difficult to ensure adequate access to a wide range of technical equipment for a suitable period.

The Japanese Interactive Video

This interactive video is also funded by DEET and is being produced by WA Distance Education Consortium.

This interactive video is to be a major resource for Australian educational institutions for use by upper secondary and beginning tertiary students in, either distance education or classroom mode. The disc will be suitable also for use in business and industry as a self-instructional or open learning package.

The project will be composed of video sequences of 5-30 seconds in length. These sequences can be linked to each other or they can be self-contained. Users select video sequences and further select ways of interacting with them.

It is intended that users will be able to:

- browse around the whole system and choose which sequence they want to work with
- choose to access sequences in target or native language
- choose the language of the sub-titles displayed, ie Japanese or English
- Choose the type of interaction with the selected video sequence

  ie repetition

  grammar exercises

  dialogue building

  role playing etc.
- choose to print out sequences in Japanese or English. They will be able to select a print out of the whole sequence, or specific character roles etc. (Note that the problems of printing Japanese text are still to be solved)
- choose to access self-evaluation tests
- choose to control the program using keyboard, mouse, or, if possible, voice recognition, a barcode will also be investigated.

Within these choices are a whole range of other options. This non-linear approach to learning offers new challenges for learners allowing them greater control in the design of their own learning experiences.

Conclusion

The notion that the traditional education system can equip individuals with sufficient knowledge to last the rest of their lives is hardly realistic. Rather individuals need to develop skills to equip them to learn throughout their lives. The major focus of higher education institutions should be to help students to 'learn how to learn'.

Introducing educational change is always frought with difficulties, especially in traditional institutions. Management and colleagues have to be convinced. It is safer in the long run to approach the change of focus from teacher-controlled instruction to student self-directed study on a 'softly, softly' basis, easing into guided self-study and slowly moving towards the goal of independent learning.

We have technology available which can make the task of producing effective guided self-study materials less daunting. Technology also makes the exploitation of materials more flexible and enjoyable for the learner. However, no matter what technology we have access to it is the teachers' skills as facilitators, resource persons and counsellors, which, in the end, determine the success or failure of the independent learning experience.

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CHRONIC BLOOD TRANSFUSION: A video and resource book to facilitate teamwork in the treatment of patients requiring chronic blood transfusion

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The program, Take Care! Chronic Blood Transfusion *was the result of a collaboration between the two authors, one of whom was at that time working in the area of instructional design in the Education Unit at the Royal Melbourne Institute of Technology (RMIT) and the other Lecturing in the Department of Applied Biology there. Other members of the working party included the Director and senior members of the nursing staff at the Red Cross Blood Bank.*

Meeting vocational needs

The Blood Banking subject in the RMIT is vocationally oriented and taken by students in the final year of the Medical Laboratory Science course. Blood Banking can be studied at a number of levels. For example, all students have a brief introduction to the topic in their second year. Those who wish to consider Blood Banking as a career option can study it as a one semester subject, and those who are already committed to a career in transfusion science have the opportunity to study the area in depth in the subject Immunohaematology.

Take Care! Chronic Blood Transfusion was designed to be used in this course as an interactive video program in response to the identification of a number of concerns and issues, outlined below, relating both to the educational processes being used in different subject areas in the undergraduate Medical Laboratory Science degree course at the RMIT and also, more generally, to vocational education.

Changes in the funding basis for the course meant that it was necessary to re-evaluate the aims and objectives of many subjects and to determine the most effective way of teaching them. It was decided to employ a multimedia approach and to develop a number of instructional packages. The degree of self-learning and student interaction incorporated in each package was determined largely by the aims and content of the subject material being covered. Another concern was the cost in terms of time and materials required to develop and produce each package.

For a first year introductory subject in Haematology it was decided to use a series of self-instructional booklets and to follow a Keller plan approach to help students understand and assimilate their laboratory based work. The booklets were produced using ReadySetGo! and make extensive use of graphics. The professional presentation of the booklets will allow cost recovery from students who are required to purchase them as their course text.

A second year subject in Introduction to Immunology requires students to come to terms with many new and often complex concepts. The grasping of concepts is often facilitated by the use of diagrams and figures. Quite often animation is also helpful where there is interaction and subsequent change in the items of interest. The computer program HyperCard™ has been used to develop a number of stacks on the various topics in this subject. Extensive use has been made of the graphics capabilities of the programme and stacks are printed and provided to students as hand-outs during lectures. The stacks are being programmed and will eventually be available for use in Computer Aided Learning.

The vocational issues related firstly to a need to categorise and define the essential elements which students are required to understand to meet their future professional requirements. As medical laboratory scientists they will frequently be operating as part of a team with other members of the health professions such as nurses and doctors. A way had to be found, therefore, to relate concepts and principles learned in the classroom to future on-the-job training in the laboratory. Another of the authors' concerns was to provide clear guidelines for teachers both of undergraduate and postgraduates as to the level and depth at which it was appropriate to present these topics to students and in what sequence, again with emphasis on the need for students to be able to recognise and apply their knowledge in practical situations. Yet another concern was the need to make more effective use of the limited teaching time available and to present the subject in ways which would encourage students to understand concepts and principles and also to become more self-reliant in their approach to learning. The vocational nature of the subject obviously lends itself to the use of a problem solving case study approach and this is the approach that was decided on.

Search for suitable material

An investigation of existing video material in the field of Blood Banking indicated that there were not many programs available and those that were, did not address the issues the authors wished to examine.

The National Heart Lung and Blood Institute in the United States had in 1984, awarded a Transfusion Medicine Academic Award to Brown University to examine the state of transfusion medicine teaching and the application of new teaching technologies. Under this award the Brown University team, led by Dr James Crowley, commenced the production of a number of interactive video programs integrating the use of computers and video. A number of videos in this series were obtained for evaluation, but, once again, the topic material and approach used did not suit our purpose.

The objectives of the program

The program was conceived as having three main objectives. The first was as described above: to show the ways in which the responsibilities of nurses, doctors and laboratory scientists are linked in the treatment of chronic transfusion patients. The other two objectives related to the need to make users aware of the most recent developments in the area of blood products together with some of the dangers inherent in lack of care and attention to detail in using the products. They were, firstly, to show some of the most recent practices and procedures in the treatment of chronic transfusion patients and, secondly, to give information on the composition and storage of red cell products used for these patients.

Although these objectives may appear to be mainly concerned with the giving of information, the authors were also concerned to influence the attitudes of students towards their responsibilities. Studies in the United States (Sazama, 1988; Honig & Bove, 1980) have indicated that most fatal transfusion reactions result from the transfusion of ABO incompatible blood. In the vast majority of cases the cause behind the transfusion of ABO incompatible blood was shown to be human error involving mistakes in patient, blood sample and donor unit identification. All participants in the transfusion of blood (medical scientists, nurses and doctors) were guilty of such errors.

A practical guide to current procedures and practice had recently been produced by the Red Cross Blood Bank (Blood and its Products), and it was felt that it was desirable to reinforce and promote vigorously the positive attitudes to good professional practice outlined in this manual. This could be done by presenting some of the content of the manual within the context of a case study which would demonstrate the practical application of the principles.

A joint venture

It was decided, therefore, that there was a need for a new program to be developed. Because of the nature of the proposed content (depicting a team situation involving nurses and doctors as well as medical laboratory scientists, it was realised that this program would be potentially as useful to these professionals in their on-the-job and continuing education as it would be to undergraduates. Consequently the Director of the Red Cross Blood Bank was approached and he and senior members of his nursing staff agreed to become part of a joint working group with the authors. This meant that from the start, there was input from all three groups and the development of the program became itself another exercise in cooperation and understanding between members of the three professions.

Development issues and their resolution

In developing the present program the authors encountered a number of problems and dilemmas. Some of these were of a practical or pragmatic nature, such as arranging suitable common meeting times for a group of diverse professionals. Some were more technical in character, such as finding a speedy and cost-efficient way to collate and integrate the diversity of inputs from these groups. This was greatly facilitated by a member of the working party inputting material directly into the computer.

The issues that concern us here, however, raise questions regarding the design of instruction. Although in hindsight, many of these matters appear clear cut, the working party experienced them at the time as complex and unclear. This is scarcely surprising since the processes of design fall into the category of problem solving processes and these are frequently ill-structured in the case of complex and 'real life' problems (Jackling et al, 1990, in preparation).

1 One of the the most difficult decisions concerned the amount of information which should be included in the program, whether that information should be given in the video or the resource book, or in both, and how the information should be presented. This is a classic teaching issue: how can we 'cover' all that students need to know within a limited time frame? In this instance, the problem was compounded by the need to ensure that the material would be relevant to three distinct groups of professionals, who although they clearly had a common interest in the material, were involved in the situation in different roles and to varying degrees of depth. For example, it was desirable that the nurses should have some understanding of what the scientists were doing with the blood samples in the laboratory but it was not necessary for them to have detailed knowledge. The doctors, on the other hand, would need a certain amount of detailed knowledge of these procedures, but not to the degree required of the practising scientist. Similarly, the scientists and doctors should be aware that there existed detailed procedures for setting up the equipment for transfusion without requiring to know the precise nature of the details.

2 Another related decision concerned the relationship between the video and the resource book. Should the program be conceived as video-led or as print-led? Was the printed page an adjunct to the video or was the video to be seen as a practical illustration of the basic principles explained in the resource book? If the case study in the video was the central focus, then did this imply that the video could be viewed as a 'stand alone' program?

From the start it was decided that a resource book as well as a video was essential to the success of the program. If, however, the video were to be viewed on its own, by someone who did not consult the resource book, if the video appeared superficially to be a 'stand alone' program, would this reflect adversely on the program if the viewer(s) decided that insufficient or misleading information was presented? Conversely, what if the resource book were studied without reference to the video? What steps might be taken to forestall the possibility of students being frustrated or misled?

Practical solutions

Let us begin with the second problem. It was decided at an early stage that the program should be video-led on the grounds that one of the major reasons for making it was to promote attitude changes in the three groups of users and the printed word by itself was insufficient to ensure this. By developing a case study which showed the progress of a patient from the start to the end of an episode involving transfusion procedures, it would be possible to represent the most important issues in a real life situation with which students could identify.

Having made the decision to create a real life situation, the next decision was whether to recreate this with the help of actors or to use actual patients and medical personnel. The choice of the latter was made on the grounds both of cost and that the professional audience for whom the video was intended would be more likely to respond positively to a real patient and real personnel. Further, the program was conceived as a teaching performance rather than a dramatic re-enactment, and for this purpose, 'real people' were considered more likely to convince learners.

Following on this point, was the question of how to ensure that teaching (and learning) were, in fact. occurring? It would be easy for a group to view the case study in a fairly superficial way. It was decided to identify a series of crucial moments in the course of the patient's history. These might be 'critical incidents' or relate to important procedural questions. At these points, the action would 'cut', and with the signal *Take Care!* a question would be posed for the student(s) to discuss or take a decision on before proceeding to the next segment of the video.

This leads us back to the first design question. How much information should be included in the program? As the focus was on facilitating cooperation amongst the three groups, it was inappropriate to include large amounts of scientific and technical information, although it was recognised, that particularly for the scientists, the knowledge component was of central importance. Scientific and technical information, however, is better presented and learned through the printed word. So should additional information relating to transfusion be presented in the resource book? The decision taken by the team, after considerable discussion, was that it would be inappropriate to burden the resource book, which was intended to be used as a work book by those using the program, with an excess of technical information. It was decided that the important focus of the programme, was to trigger discussion within local settings of the issues highlighted in the video. The function of the resource book was to remind students of these questions and to provide a series of ancillary questions for discussion relating to these issues. Although the importance of the technical knowledge was fully recognised, it was seen as being the responsibility of whoever led the discussion groups, to provide access to such information within the local setting. One of the interesting features of the experience of developing this program was the movement from the concept of a self-instructional package to an open learning programme or module. The main features of a self-instructional package relate to its self-contained nature. It offers instruction in a specific area, and it provides all the information required for the student to acquire the relevant knowledge and skills without recourse to outside resources. A self-instructional package addresses itself to each unique individual and takes little or no account of the individual's environment. The very term 'package' suggests strongly that all that the learner needs is provided within the package. Open learning, on the other hand, addresses itself to the learner within his or her environment and, equally, to groups of learners within specific environments. For the learning to be complete, the learner must use the information provided within the context of the environment. In the case of this program, the environment may be the undergraduate classroom where the student will have the benefit of the teacher's experience and learning. But it may also be the clinical setting of the hospital where it may be used by clinical teachers and supervisors who draw on their particular expertise and specific 'local knowledge' to encourage the students to develop their own structures of learning which internalise the concepts and principles in the context of the real needs of patients and the organisational pressures to cooperate with others to achieve the best outcomes in patient care.

Conclusion

The program has been trialled with a group of final year Medical Laboratory Science students who have had limited exposure to blood banking practices.

Student feedback was very positive with respect to the case study approach employed. They found the program of value in showing some of the practices that take place in the ward at the time of a blood transfusion being given.

Their main interest was directed to the segments of the program which entailed activities in the blood bank. They responded well to the open-learning environment created by the video as it allowed them to put much of their theoretical knowledge into a practical situation.

Because of class timetabling, there was a relatively short time available in which to use the program with students and it was only possible to view part of the program. To view the entire program would probably take at least three separate sessions for Medical Laboratory Science students. This time requirement may not apply to nurses or doctors who are viewing the program to gain different information. Using the program on a number of different occasions may be a distinct advantage and permit issues to be discussed again after time for reflection on various aspects of the case study.

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Interactive videotape and videodisc language packages

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This Paper discusses a Pilot Interactive Language Package which is being developed to enable major language difficulties facing any new-comer to Australia to be encountered and overcome well before the need to interact arises.

The Pilot introduces concepts and interactive video and videodisc techniques which are used in the complete package of four units. Areas being developed within a Pilot are: Social Contact Language, Business Contact Language, Cultural Differences, and Study Skills. Concepts, teaching methodologies and skills areas which will be covered in the complete package are previewed in this Paper.

Interactive education and the use of interactive videodiscs as part of interactive educational programs and projects are becoming more and more commonplace. The use of such mediums offer an exciting and flexible medium for teachers of English as a second language.

This paper outlines an interactive language education project being developed by the authors. Interactive videotape and videodisc is being used as the vehicle for an interactive language project.

Interactive language acquisition

It is a common experience of English as a Second Language (ESL) teachers. to encounter students having a good knowledge of English language structure, vocabulary and function (in controlled communicative environments like ESL courses), yet to have severe problems in participating in authentic conversation modes — where rapid speech, interactive native speaker dynamics and problem-solving language skills are naturally employed to resolve an immediate issue or to simply engage in idle chit-chat. This shared native-speaker knowledge essentially involves "knowing the rules" of the conversation game; usually quite a different game than most non-native speakers are used to playing.

This linguistic minefield includes being able to use appropriate register (formal, idiomatic, local, slang and so on), communication signals which introduce semantic content, acceptable expressiveness, body language and gesture (non-linguistic features), understand turn-taking rules and many more elements of verbal and non-verbal communication that native English speakers take for granted.

It is this overall inability to operate adequately in uncontrolled communicative settings that causes great despair and frustration amongst non-native speakers; whether they be expressing a point of view in a boardroom or responding to an opinion in an informal social conversation.

The difficulties in interactive language acquisition is as daunting for foreign business people, government representatives, cultural groups and students as it is for the migrant language learner in the classroom. While the pedagogic value is needs-based, the implications of commercial viability are also extensive.

Video–based material in ESL

With the steady increase in immigration activating the burgeoning of ESL-provider institutions, ESL teaching methodology continually seeks to provide students with an experience, both linguistically and socially of the culture, in which they will have to operate. Ideally, the language problems confronted in the classroom will be equivalent, or at least relevant to those the student will face when operating within the community. Unfortunately, judging from feedback from legions of past students, this is often not the case. The experience of not being able to function effectively in real interactive language situations can be devastating.

Video-based material has become an increasingly important part of ESL teaching methods (usually in the form of off-air television programs, formatted by individual teachers to suit their immediate needs). This has mostly been in the form of comprehension-testing and discussion-provoking, rather than analysis and evaluation of participants in authentic communication scenarios. Reasons for this are obvious: there are almost no materials of this type available. Much of what does exist is generally second-rate (with notable exceptions).

Video, interactive video and interactive videodisc

Both large and small systems, from video player and monitor to computer videodisc player, video monitor, peripherals, offer the ability to merge video image with computer graphics with computer software. Many office computer manufacturers are marketing video enhanced models to be sold to corporations as training devices for the users of standard machines.

Home computers are available with interface cards to control the operation of home video discs — for example, quite some time ago Micro-Ed of the USA marketed a Commodore 64/Pioneer consumer laser video player interface. Similar interfaces are available for use with Apples II and Apple IIe microcomputers. With this wide range of micro-computer/interface cards/video disc players on the market, they may become common place in homes and offices during coming years.

As long ago as the Japan Electronics Show of 1982, some Japanese consumer-oriented companies offered integrated microcomputer/video systems. Sharp displayed its X1 system, which comprised an eight-bit computer, a 14 inch colour television monitor and optical "Teletropper" which enable the computer to be connected to a video camera, video tape recorder or video disc. It allowed computer graphics to be superimposed and displayed simultaneously over video images and television signals. This is made possible by a RGB mix circuit. Sharp named the concept "Visual integration" and called the X1 the world's first personal computer/television monitor system.

Microcomputer systems linked to video players show great potential for use as a simple interactive teaching unit, which could be suitable for ESL programs. But the availability of integrated microcomputer/video systems (and especially those containing video discs) enable the production of highly flexible (and very usable) teaching packages containing dynamic programs in a format acceptable to a variety of students, from beginner to advanced, from newcomer to one wishing to improve interaction in the English language.

Optical videodiscs are looked upon by program developers as a new and innovative means assembling interactive teaching units and packages. There are a number of reasons for this, including high storage capacity (54,000 frames on one side of a videodisc), random access to each "picture" or videotape sequence, the disc player can be interfaced with a microcomputer (allowing software control of scenes on the disc), an almost limitless variety of programmed alternatives and branches when developing teaching units from any one disc and there is virtually no wear of the disc with the laser-reading device.

Video discs offer a means to produce a software-controlled system to display video/computer graphics and audio in a static or dynamic mode. Programs can be written using an integrated personal computer/interface card/video disc player equipment package.

The advantages of optical disc format over lineal videotape for language acquisition are mainly concerned with the interface available for interactive computer-driven sequences for optimum exploitation of the materials. The random-search mode of teaching resources on an optical disc allows for a rapid selection of desired linguistic (or non-linguistic) features of any conversation sequence on the disc, rather than the tedious, almost impossible operation of rewind/find and play modes of videotape. Add to this the ability to store student responses, the analysis of these responses and then the re-formatting of particular individual teaching strategies as a result of analysis, then the true teaching power of such a package can be appreciated.

Language package content

It is proposed to concentrate on four specific areas of interactive language which present major difficulties to any new-comer to Australia. These will be presented as four language teaching units, namely:

1 Social contact language

2 Business contact language

3 Cultural differences

4 Study skills

Action/teaching scenarios within each unit will take place in authentic locations and will demonstrate typical everyday as well as the more formal business language interactions. This will highlight cultural and social differences between those practiced in Australia and elsewhere.

These variable language and social dynamics depend upon a number of factors. These include mode, setting, communicative function, group familiarity, shared cultural knowledge, occupation, temperament and so on.

Pilot

General

As a research program, a pilot videodisc—programs, videotape, audio tape, videodisc and a comprehensive user's guide is being assembled. A "combination" of microcomputer, composite VDU, and "laservision" videodisc player is being used.

Production will involve scripting, filming, editing and the assembly of a BVU master 3/4 inch video tape. Once complete, a videodisc will be manufactured and programming of interactive routines using "Turbo Prolog" will ling appropriate teaching units.

The material will be re-formatted and re-published in Digital Video Interactive (DVI) when that technology is commonplace.

Methodology

1 Production of teaching units using conventional videotape facilities and techniques

2 Editing to produce a master BVU 3/4" videotape with appropriate "headers and footers" to allow for videodisc production.

3 Production of a "glass master" videodisc.

4 Development of flowchart for interactive routines.

5 Programming interactive routines in "Turbo Prolog".

6 Production of text and guide for instruction package.

7 Packaging and promotional materials production.

Developmental Videodisc hardware being used:

- Compaq XT Microcomputer
- MIC 2000 Videodisc Controller Cards and software
- SONY LDP 1500 Laservision Videodisc player
- SONY KX 14CP1 composite VDU

All the production tasks, with the exception of production of the master glass disc will be done within RMIT by the authors.

Language Package

It is envisaged that three versions of the language teaching package will be made available.

Version #1 will consist of videotapes, audiotapes, transcripts and text.

Version #2 will contain videotapes, videodisc, transcripts and text.

Version #3 will contain videotapes, videodisc, transcripts and text and will include a training program presented by the authors for in-house training personnel.

Tailored packages of teaching kits, hardware and training programs will also be offered after consultation with individual clients.

The Authors expect to liaise with commercial marketers of educational media when the products are complete and marketable.

Target-User Group

ESL teachers in Australia and off-shore, visitors to Australia (business people, government representatives, cultural groups, students and tourists) and new-comers alike will be able to use the package as self-directed self-paced programs. On-the-job or remedial employer-sponsored schemes would use the package. Those involved in linguistic research are also seen as potential users.

Conclusion

The packages being developed will teach appropriate language registers, communication signals, acceptable body language and turn-taking rules. Elements of verbal and non-verbal communication techniques that native English speakers take for granted will be explained and practiced.

After completing these four self-paced language, cultural and study skills units a newcomer to Australia will be able to comfortably and positively participate in social, business and educational activities by "knowing the rules" of the conversation game.

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The use of interactive video conferencing in education and training: Recent developments in Victoria

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How are things down on the farm?

On March 21, 1989 several dozen Victorian farmers drove to a number of isolated rural sites to discuss their concerns with a leading national taxation authority.

Greeted by a local tutor at each site, and provided with printed support material and a teleconferencing terminal, they were ready to begin.

At that moment, hundreds of miles away in Melbourne, a crew of three was using simple VHS equipment to televise the presentation by Mr Geoff Nielson to the farmers.

The program was delivered live via satellite and participants spoke directly to the presenter by way of a telephone conference.

Simultaneously, in Mildura several hundred observers (teachers, students and interested community members) packed the reception site at Sunraysia College of TAFE (SCOT) to witness the inaugural Sunraysia Project video conference into Victoria's remote northwest.

Video conferencing configurations

As it has developed in Australia, video conferencing for education and training can be configured in a number of ways according to the requirements of the learning program.

The most prominent systems are:

1 Two way conferences linking designated campuses. Using optical fibre lines, these systems are generally used to deliver regular on-campus accredited courses on a continuing basis. These systems can also be used effectively for administrative purposes between campuses. Both the sound and visual image are received simultaneously at either point via the television receiver. This two-way communication of sound and video is accurately termed video conferencing. The two remaining systems are often discussed under the same banner, but are not strictly video conferencing.

2 One-way video/sound to a single point usually delivered by optical fibre lines (satellite is an expensive option to single sites). Conferencing is achieved by providing a separate

sound link from the reception site back to the teaching point — usually a telephone link. This system is best suited to programs which are about "one-way" teaching/instruction, but require interaction via the audio link. The teacher does not require a visual image from students at the reception site. Generally the reception site is located on a campus and is devoted to the provision of accredited on-campus courses at a distance.

3 One-way video/sound via satellite to multiple points, interaction being provided by a telephone conference linking all sites. As with the previous system, this one is used where one-way visual instruction is required alongside two-way audio. With this system it is possible to use all or some of the V-SAT(Very Small Aparture Terminal) and TVRO (Television Receive Only) sites according to need. Significantly, flexibility can be increased through the provision of mobile sites which can be set up for single programs, unlike fixed facilities on campuses. The number of participating sites is limited to the capacity of available telephone conference bridging equipment (recently increased from about 20 lines to 60 or more through Telecom's new conferlink service) which provides the audio feedback link. This system provides widespread coverage beyond a campus and is suitable for a range of programs.

The Sunraysia Project

The Sunraysia Project's telecommunications system has been configured according to this final model as it reflects the broad ambitions of the project.

The project, which has been a joint venture by the TAFE Off-Campus Co-ordinating Authority in Melbourne, Sunraysia College of TAFE and the Gordon Technical College in Geelong, has focused on the use of video conferencing for off-campus delivery. A Commonwealth Government grant was provided to establish satellite transmitting and receiving facilities and to pay for an initial block of satellite time. The project presently consists of a network of 16 sites.

A major emphasis has been on the provision of access to education and training opportunities where these would not otherwise be available, or could only be presented by less effective means.

Had a terrestrial link accommodating two-way conferencing to Mildura been available at the outset, it would not have met the project's requirements. Such a link will soon be established but it will only enhance, and not replace, the method of satellite delivery to outlying locations.

The Victorian government's expanding terrestrial (fibre optic) telecommunications network (VISTEL) linking Melbourne with regional centres will provide a less costly system of delivery which can be integrated with the satellite delivery system according to the needs of a particular program.

Programming

The Sunraysia Project is a response to the very real need to overcome the isolation of a large community from existing government services due to the absence of effective and efficient methods of delivery.

In part, the project has trialled the delivery of regular on-campus courses into the Mildura campus of SCOT However, it has largely been concerned with encouraging, and then training and supporting, a variety of program providers to deliver a range of programs to largely off-campus locations.

A number of the video conferences have been one-off, fee-for-service programs which have complemented a broader study package. In the case of the inaugural 'Taxation for Farmers' program described at the outset, participants could enrol for the video conference presentation supported by a local tutor and study notes (cost $20), or they could include it within a larger course of study (cost $60). This program reflects the project's aim to provide integrated study packages featuring the video conference component. Each of the programs has proceeded on the important principle that it would not constitute a stand-alone, low-level technology television program.

Programs transmitted under the Sunraysia Project have included a professional workshop on the disabled in employment and education, social science and business studies programs, and a VCE English exam preparation seminar for country secondary students.

The most recent transmission was a program on ergonomic furniture and the application of ergonomic principles to office procedures. This program was transmitted from Melbourne to the Sunraysia College of TAFE and five prisons around Victoria, each of which had installed a satellite dish (temporarily relocated from other Sunraysia Project sites).

Technical Obstacles

The Sunraysia delivery system has presented certain problems in a number of programs. Overcoming these limitations has become a project priority.

The most regularly frustrating technical problem has occurred with the teleconferencing. Often one or more sites have encountered difficulty for part or even an entire program.

Frantic efforts are then required as the program continues, to improve or restore the telephone signal to the affected site(s) to enable full interaction. Where the problem has continued throughout a program, those participants have still been able to receive the inward video/sound signal and have heard exchanges between other sites and the teacher through the television receiver. In these circumstances interaction and therefore active student involvement has been lost.

Generally, these problems occur at the point of the telephone conference bridging equipment and Telecom is being pressured to address this issue. To date, no interference has occurred with the live television signal at any site during any program. The general practice of transmitting a visual/sound signal prior to the actual program allows all reception sites to tune their receivers if necessary.

All programs transmitted under the Sunraysia Project have been conducted at a band width of 2MB. This has resulted in surprisingly good quality images, and has been more than capable of meeting the demands of 'talking heads', use of graphics and charts, prerecorded video, demonstrations of practical skills and the operation of technical equipment.

Video conferencing principles

Lessons we have learnt through the experience of transmitting the Sunraysia Project programs suggest to us a number of important principles to be observed in planning and conducting video conferences. Attention to these principles (which are by no means exhaustive) should save future users of video conferencing considerable time and anxiety.

Presentation Style

Sticking rigidly to a detailed script leads to a very wooden presentation. A script/lesson plan should necessarily be a flexible guide.

Despite the mix of programs and content areas covered under the project, all of the teachers and presenters (often non-teaching professionals in a particular subject) have shared a common ability to conduct themselves in a confident conversational manner.

Composure before the camera is essential.

Staff Development

A consistency in presentation (which in itself is vital) has been brought about in the Sunraysia Project by a program of staff development for teacher(s)/presenter(s) conducted by staff from the TAFE Off-Campus Coordinating Authority. The experience of previous programs is shared with new presenters and experience has established a number of basic television presentation techniques which assist any presentation.

Prior to the program, ideally at a rehearsal if this is at all possible, the novice presenter is made to address, among other things:

1 Overall appearance and suitable dress (glasses can create distracting reflections).

2 Vocal dynamics, ie avoidance of a monotone

3 Methods to involve student activity in the program.

4 Telephone conferencing protocols and procedures (essential for a system depending on audio-only interaction).

5 Structuring the program to maximise student interest and the effectiveness of the medium.

6 Capitalising on well-produced, relevant graphics.

These concerns may be thought of us as the "down" side of using what is normally an exclusive technology. However, most of these basic skills can be acquired readily once the presenter has been made aware of them.

Television Protocols

The presenter and crew involved in a video conference cannot ignore the fact that the television camera is an intrusive instrument and that students/participants are extremely literate in basic television programming protocols. Although video conferencing cannot, and should not, attempt to compete with the standards of broadcast television, it is directly related to that medium. Each student will bring to a video conference an expectation of what television "looks like". Abiding by the basic television protocols may prevent a student becoming distracted from the program content.

Basic protocols include:

a Presenter looking into the camera or to a chairperson/interviewer (not somewhere in between).

b Graphics should be legible and designed (and redesigned if necessary) according to the needs of the student rather than the prior knowledge of the presenter.

c If two (or more) people are on camera, shots should be matched in terms of camera angles and the size of people in the frame.

d Dress should be appropriate for the program content and the expectations of the audience. Stark white, all reds, fluorescent colours, and fine checks etc, should be avoided.

e Lack of variation in camera shots induces boredom. A close-up engenders more intimacy and involvement and can instantly convey a presenter's sense of commitment and self-assurance, (but equally, extreme nervousness is instantly and painfully obvious).

The most important skill any presenter can master is the art of looking confidently into the camera and therefore at each student. Where there is no group of students at the presentation site to teach to, it can be useful to position someone alongside the camera to develop a sense of audience and proper eye contact.

The project's most effective programs have been those where the presenter is able to develop a sense of personal dialogue with one or more participants at each reception site. This technique can help to avoid embarrassing silences when questions are put to groups of anonymous students.

Teleconferencing Protocols

In any program, the presenter's first task is to confirm that all sites are receiving the video/sound signals and are linked to the telephone conference. It is at this point that a system for taking questions from sites can be established by the presenter. During this initial round-up of sites, the presenter should take the opportunity to break the ice by encouraging a quick exchange in each instance, thereby making later participation more likely.

Chairperson/Host

The Sunraysia Project has established the important role of a chairperson/host who can introduce the program, conduct the telephone conference, contribute to the exchange of information by putting questions to the presenter where necessary, and generally allow the presenter to concentrate on the program content. This is an even more critical role when multiple reception sites are involved or where technical interference occurs with the telephone conference.

Tutor support

Providing integrated study packages, not merely television programs, has serious implications for the provision of human and other resources, as well as for the coordination of the entire delivery network.

This approach necessi[illegible] the establishment of a coordir[illegible] [illegible]vork for the efficient distribu[illegible] [illegible] any support study materials [illegible] advertising brochures or enrolment forms; for fees collection (if required) and the provision of on-site tutorial support; as well as the operation and maintenance of the V-SAT and TVRO facilities.

Much work has gone into staff development activities to promote the specific role of the local tutor for video conferences. At isolated reception sites, the local tutor functions as the host for students and must necessarily perform a number of tasks. Chief among them is to prepare students for the style of program they are about to receive; that is, it is not broadcast standard, and in contrast to passive viewing of regular television, in video conferencing participation is the name of the game.

The local tutor also has a crucial instructional role and is vital in the identification of key issues, the clarification of different points and in prompting valuable questions from the group. The tutor's role is absolutely vital when the live video presentation is divided into separate segments separated by on-site activities and study between transmissions.

Economy of effort

Video conferences are generally more successful when several of the production/technical/instructional design roles are performed by the one person. The rigid distinction between production roles and the understandable concern to produce a quality product, must be weighed against the certain impact on cost resulting from large crews.

Major issues in video conferencing.

Lack of flexibility in "real time" programs?

In the eyes of its critics, video conferencing is rigidly scheduled, thereby denying students any flexibility for study and negotiating convenient access according to the personal circumstances of distance education students.

Certainly, unlike telephone conferencing which is particularly convenient, video delivery requires students to assemble at a specific location and at a prescribed time.

The concept of flexibility (access) is not, however, simply one of time and space. The Sunraysia Project has successfully provided access to resources, education and training which would not otherwise be made available, or would be provided in a less satisfactory form. Through its programming, the project has established that interactive video conferencing can be an effective and preferred method of program delivery.

A hidden problem for staff development

Some months into the project, a fundamental flaw in the entire operation was exposed. Considering the possible opportunities for involvement, through management and project committees, and as presenters and production crew, there had been very few women involved.

The Sunraysia experience points to the need to actively provide opportunities for women to participate in order that they may have an effective role in the application of this significant technology, and in determining policy and procedures governing its use in education and training.

The project sought to redress this imbalance by actively cultivating the involvement of women production staff, hosts and presenters of programs. Such a staff arrangement was responsible for an examination preparation program for country VCE students in October, 1989. Subsequently, women have play'd key roles in several programs.

It is intended that a resource base of experienced women be established to assist with, and actively encourage, the increasing participation of women in future video conferences, both behind and in front of the camera.

Need for coordination

One of the successes of the Project has been the cooperation between the various sectors of tertiary, TAFE and secondary education which has taken place in a number of programs.

In turn, this has highlighted the need for the coordination of any further developments in video conferencing in Victoria (and between other states) beyond the Sunraysia trial.

Staff development, resource allocation, programming and the accessibility of programs are all factors which should be coordinated by a responsible authority.

If this occurs, it becomes relatively easy for an interested educational institution, government agency, or industry or community group to mount a program.

However, failing proper coordination of video conferencing, individual institutions will continually face the gulf between the potential widespread communications network available to them, and the limitations on their own resources to maintain and utilise that network.

Given the cost of video conferencing, many programs may only be effective when access is guaranteed to a wide range of reception sites. (A reception site fee or individual student fee may help to recoup costs).

Teachers and video conferencing

It is particularly instructive that almost everyone involved in the Sunraysia programs comes from an educational and not a technical background. Key staff have generally combined teaching experience with significantly less expertise in television production. The comparative success of the Sunraysia Project is due in large part to this factor.

A range of approaches may be adopted for video conferencing productions. Very simple programs may be transmitted by one person in a suitably equipped "studio" using a panel of buttons and switches remotely controlling a fixed single or multi-camera set up. The Sunraysia College of TAFE has developed such a facility ("SCOT COM") which may also be used in more complex programs where the basic console is linked to supplementary equipment and operations.

The decision concerning the degree of production complexity built into a program should be an educational one. That is, do what is required to achieve the educational aims. All Sunraysia Project programs have been produced using two (cheap, VHS portapack style) cameras, with a small vision mixer and standard lapel microphones. Most programs have used a crew of three people.

The crucial point of this discussion is that video conferencing will be most effective when it is in the hands of appropriately trained teachers. It does not require significant expertise in television production. In the course of the project, generally the greatest resistance to video conferencing as a learning medium (especially criticism of its low-grade production levels) has come from qualified television production staff at educational institutions.

Any attempt to hand over responsibility for video conferencing to production staff in the "white elephant" television studies common to many campuses should be resisted strenuously.

Video conferencing has little to do with television beyond initial appearances. Principally, it is about teachers/instructors doing what they do best; that is, providing real-time learning experiences to students (sometimes in a classroom, sometimes at a distance). That a relatively exclusive technology is employed should not overly concern any of us. It is simply another learning medium.

The future of video conferencing

In Victoria, a range of future programs is planned in support of accredited off-campus courses in real estate studies and further professional development for real estate practitioners. Trialling the statewide delivery of professional training and development of officers in the Victorian ambulance service is also planned.

Beyond the lifespan of the Sunraysia Project, the future of video conferencing is less clear. It may be picked up by commercial organisations (IBM has just installed its ISEN system for training using two-way video conferencing). In educational institutions video conferencing will be an important part of flexible delivery strategies, if the technologies associated with the range of flexible delivery strategies are adopted and used in mainstream programming.

The basis of the infrastructure is in place. But the main battle will be to change the attitudes of teachers and administrators to allow existing recurrent funds to be redirected to support video conferencing and other educational technologies. It would be a pity if video conferencing were confined to the fringe of educational programming for short range or "one-off" fee-paying activities. It has great potential as an educational medium to be used in conjunction with established technologies and teaching practices, as well with as the emerging computer and associated telecommunication technologies. It is not a universal panacea, rather one of a large number of educational options.

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Developing instructional videos in Indonesia

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The development of instructional videos requires a combination of technical and instructional skills. Developing these in a overseas country presents additional problems for the expatriate advisor. This paper is based on my work as a media advisor in an Indonesian teachers college where one of my major roles was to develop instructional videos.

In 1987 I was employed as a Media Advisor by the Indonesian Australian Technical Education Project (IATEP). The IATEP project had been involved in upgrading the skills of teachers in technical and vocational education in Indonesia for many years.

I worked at the Vocational Teacher's Upgrading Centre (VTUC), in Jakarta, as a long term advisor in media. The VTUC has a dual role:

- It is responsible for conducting in-service activities to upgrade the skills of practising teachers. These activities are of two to six weeks duration.
- It also conducts an initial three year teaching diploma.

The short courses are conducted in the areas of media, food, clothing, business, office administration, accountancy and secretarial studies. The courses are conducted by master teachers at the VTUC. Master teachers are experienced teachers who have undergone additional training in Indonesia. Most of the master teachers had been to Australia on long term fellowships for six to twelve months as part of the IATEP project.

The role of the long term advisor was to work with an Indonesian counterpart to follow-up their training in Australia and assist them in the overall operation of their department. At the VTUC, I worked in cooperation with the head of the media department. The media department consisted of seven Master teachers and one technician.

My role was to change the media department from a teaching department to one having a major role in program production. Since there was a large amount of video equipment available there was great encouragement for me to fully use the equipment by producing instructional videos.

The role of the media department at the time was to teach student teachers and to conduct upgrading courses for practising teachers from all over Indonesia. The media department was similar to an educational technology department but taught various aspects of media use. There was no program production taking place for other teaching areas at VTUC.

All the media centre staff had up to one year fellowships in Australia to study educational technology at the Hawthorn Institute of Education and had work experience at a TAFE college.

Problems of working as an advisor overseas

Advisors working overseas have many professional problems to overcome. Two of the mains ones for me were:

- The advisor is an "advisor" to their counterpart staff who can accept or reject their advice. The advisor has no authority within the organization; they are trying to assist.

- There are cultural differences between Australians and Indonesians. Indonesians tend to agree with everything you say even if the don't. As the research of Cannon (1989) has shown that Indonesians, more than Australians, prefer to have good relations with everyone. This can lead to problems if your counterpart only superficially agrees with your advice.

Problems of developing instructional video

The problems included:

- inadequate television studio

- diverse range of television equipment

- only one TV technician

- the subject matter experts and the media staff had no experience in applying instructional strategies to video

- lack of time of the media staff and the subject matter specialists for program development

- lack of funds

Method of program development

Initially, I attempted to run mini workshops on video production with the media staff, I taught subjects such as lighting, editing, sound recording and character generator use. However, this did not prove very successful because the staff could not see how the individual skills were to be of any major use to them professionally. Also they regarded practical skills as inappropriate and thought this type of work should be completed by technicians.

Another problem was my lack of Indonesian language ability. As stated by Cannon (1990) when describing the language problem,

> *Lack of skill in the language of the host country is a more difficult problem, but, in theory at least, this can be partly resolved by moving away from formal presentations toward interactive problem-based learning.*

To overcome my previous problems, I decided a more coordinated approach to training was required. I developed a new training plan based on the following objectives:

- Upgrade the television skills of the technician and the media staff, so they could form the production crew.

- Develop the skills of the media staff in applying sound instructional design techniques to video programs.

- Establish the media department as "experts" in developing video programs.
- Establish the scripting skills of the media and subject matter experts.
- Develop the project management skills of the media staff.
- Create an interest in developing instructional video programs.
- Involve local personnel experienced in video, in teaching the courses to overcome the language and cultural problems.
- Provide work experience for the media staff in educational television.
- Visit other video production facilities.

The plan is shown in the associated diagram

In full consultation with my counterpart three formal training programs were planned with associated training activities.

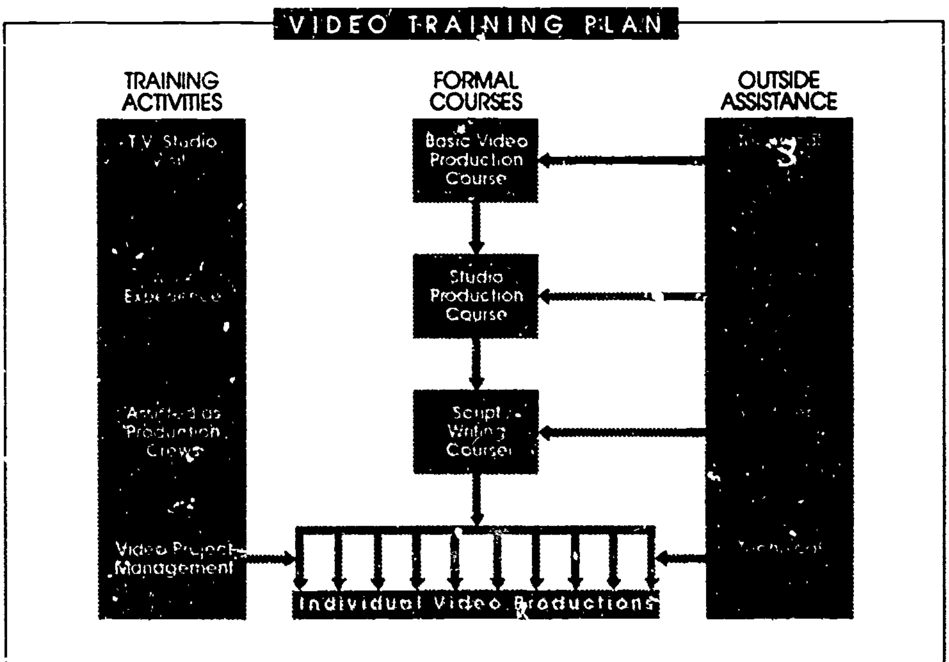
The courses were:

- Video production techniques
- Studio production
- Script writing.

Other training activities included TV studio visits and work experience for media staff.

Video production techniques course

The Video Production Techniques Course was designed to train the media staff how to operate the video equipment. Several other staff were involved in the training so a large resource of people was available for production crews.



Topics covered included:

- lighting
- audio
- graphics
- administration and planning
- pre-production techniques
- scripting
- editing
- instructional design and video programs
- practical workshops

I decided to involve other local staff in the training rather than doing it all myself I used staff from our sister college, the Technical Teacher Upgrading Centre (TTUC) at Bandung. At TTUC they were quite well equipped with a high-band television studio. The TTUC staff were well experienced in video production. The course ran for four days. The result of the course was that we then had staff who could form production teams when required.

Studio production course

The Studio Production Course was conducted at TTUC Bandung which had a suitable studio. This gave my staff an idea of how an established TV studio operated. A program was scripted and was planned to be shot at TTUC using VTUC staff to operate the studio. The students were involved in the complete production of an instructional video for the first time. There were no formal classes but the students were shown how to operate the studio and other equipment. They shot and edited the program under the guidance of Indonesian supervising staff. This course ran over three days.

Script writing course

Several weeks later a Script Writing Course was held. This was conducted at the VTUC, again with the assistance of the staff from TTUC and the media advisor. The objective of this course was to allow the media staff to work with staff from other subject areas in the production of a script. Each media staff member worked with subject specialists in the production of an instructional video.

Topics covered included:

- Why use video?
- Instructional design and video production
- Scripting techniques
- Samples of instructional videos
- Mini video — productions
- Mini groups — scripting

At the end of the course subject specialists had completed scripts in their mini groups. It was assigned to a media staff member to complete the program with the help of the subject specialists and using the other media department members as the production crew. This course ran over three days.

Over a three months period ten video programs were produced. During this period they had the continued technical assistant of staff from TTUC Bandung.

Other training activities

The other activities included visits to other video production units. The staff saw how other studios operated. In addition they looked at the physical design of the studio and this was helpful because they were re-designing their own studio.

We also arranged for the placement of the media staff for work experience in various video production houses. Here they learned practical production techniques of other colleges.

Why these courses were "successful"

The courses were successful in that ten instructional videos were produced and the media department staff developed video production skills.

Some of the advantages of the courses were:

- The courses were given a degree of importance within the college. The formal opening and closing ceremonies of the courses were always attended by the Director and other senior staff within the college.
- The participants were required to produce scripts during the course and were very involved in decisions about their program. They then had to complete the program in their own time.
- The subject matter experts worked with the media staff directly. The media staff were in charge and totally responsible for the production.
- The media department formed the basis of the production team, and since there was only one technician, the media staff doubled as the production team for each other.
- There was a slight competitive element to see who could produce the best production, especially as the Director and other senior staff would view the videotapes.
- The staff learnt from their colleagues and their sister college, as well as from advisors and experts in the wider community.

Unexpected outcomes

The unexpected outcome of this training plan was that closer cooperation between my college, the VTUC, and their sister college, TTUC Bandung occurred. There was genuine cooperation and friendship between the two colleges.

Conclusions

According to criteria described by Cannon (1988), the courses had a teacher-centred approach as opposed to student-centred. In the teacher-centred approach, the content is specified by the advisor. However there was a great degree of student involvement in the course and follow-up activities which allowed the students to apply the knowledge they had learnt. In addition, the use of local staff rather than expatriate advisors, overcame many language and cultural problems.

As an advisor, I acted as a facilitator rather than on my expertise alone in my role as an expert applying my practical experience as an instructional designer to solve problems in another country. For the expatriate advisor to rely on their expertise alone and not use the professional expertise already existing in the country is a mistake.

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Educational technology in Malaysia: The resource centre as a unifying concept

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My first contact with Malaysia was a professional education conference held in Kuala Lumpur in January 1970, where the language of communication was English but the methods of presentation were largely talk with little presentation technology. At that time, I had only just arrived in Asia and the sounds and smells were so exciting and different, that I hardly noticed the lack of resources. Recently, I was invited to return to present the Keynote paper to the Second Malaysian Educational Technology Society Convention. After twenty years, I noticed a definite maturity about the way in which people were approaching educational technology. The sophistication was not only in the technology employed but in the concepts held about its appropriate use. In the intervening years, I had been fortunate to be a consultant to one of the premier Malaysian universities in the area of educational technology, and been a consultant and examiner to other universities in the same country.

In reporting his experiences over a similar period, Don Ely compared three developing countries, Peru, Chile and Indonesia. In summarizing his conclusions he stated:

> *Educational technology is alive but not well in all three countries. There are diverse applications, but no unifying concept. Principles are transferred from more developed countries, but there is a lack of understanding on part of decision-makers on what is meant by educational technology. This field must be defined in the cultural context of each country. The field must emerge as an indigenous innovation, not a transfer from another country. (Ely, 1990, p1)*

It is this context in which arises a difficult problem for Malaysia. The country contains an interesting series of paradoxes. At one time, it is possible to obtain the latest in educational technology and software, and at the same time, many classroom teachers are still working with simple, non-projected, self-made materials such as models and charts. It was pointed out to me by members of the convention that books are still precious items, despite the increase in the number of local books which are published for classroom use. The dilemma also extends to the implementation of educational technology ideas.

One of the best examples is the application of the resource centre concept to schools and districts (Tow & Zubir, 1985). While the educational technology ideas are adopted there are problems with their execution. There is a confusion about what are the key elements of the innovation and how can they be employed in the Malaysian context. The issues in Tow and Zubir's report are not unique to Malaysia or a developing nation. Problems of supply, and government bureaucracy are universal problems for educational systems. But when also dealing with unknown concepts the problem is doubly difficult.

Educational technology in Malaysia has had considerable support from the Education Ministry and government authorities. In fact, compared to Australia, there is remarkable coherence and organisation. Scarcity of resources has created a climate where sharing has created links not often seen in Australia. For example, Malaysian school libraries are part of the Educational Technology Division of the Ministry and participate in the growing sharing of resources through Resource Centres at school district and state levels.

In this brief discussion, some of the key developments which demonstrate clarity and direction for scarce resources will be raised. These basic components of the situation can provide a useful picture of the application of education technology.

Creating an organisation to support educational technology

The Educational Technology Division (ETD) formerly known as the Educational Media Service (EMS) was established in 1972 with the main objective of helping improve the quality of education in Malaysia particularly in the rural areas. It was believed that the technology would help make the teaching–learning process more effective. Prior to 1972, there existed an Audio Visual Unit in the Ministry of Education and a Schools Radio Service in the Ministry of Information and Broadcasting. Following the success of two pilot Educational Television (ETV) Projects in 1965 and 1966, and the decision by the Government to introduce an ETV service on a permanent basis in 1972, these three services were integrated to form a new Division of the Ministry of Education called the Educational Media Service. This service was charged with providing a viable educational media and technology service for schools. The objectives of the division are:

1 *to create awareness of the important role of educational technology for the development and progress of education in the country.*

2 *to assist in providing services that can help strengthen the teaching and learning process especially tor the benefit of the schools in the rural areas.*

3 *to encourage teachers to present their lessons in more creative and innovative ways through the use of a variety of educational media.*

4 *to motivate students to obtain knowledge in a more interesting and effective manner through a variety of educational media.*

5 *to assist in providing services in teacher training both preservice and in-service especially in the field of educational technology.*

6 *to assist in the planning and implementation of reforms in learning and curriculum.*

7 *to provide advisory services and technical assistance for the effective use of educational media equipment.*

8 *to disseminate information on the reforms and developments in the field of education to teachers and parents. (Abdul Hamid bin Ayob, 1989, p 11–12)*

Infrastructure and Administration

The Educational Technology Division is one of the twenty Divisions in the Ministry of Education. As the ETD prepares and produces educational radio and educational television programs for transmission using the National RTM networks, it works closely with the Department of Broadcasting of the Ministry of Information as well as the recently privatised Telecommunications Company of Malaysia (formerly the Department of Telecommunications).

The Educational Technology Division has six different Sections—Educational TV, Educational Radio, Audio Visual, Library, Evaluation and General Services, and Engineering. The Division is headed by a Director who is responsible to the Director-General of Education and he is assisted by a Deputy Director and a staff of about 250 in the six sections. Each Section has an Assistant Director who plans and administers all the activities in his/her own Section. At the State level there are the State Educational Technology officers whose functions are to coordinate and help implement the ETD programs, activities and projects.

The ETD with its staff and activities at both national and state levels strives to provide an integrated educational media service for over 6,500 elementary schools, over 1,150 secondary schools and 28 Teacher's Colleges in the country. The target school population is about 2.2 million elementary school children, 1.3 million secondary pupils and about 180,000 teachers in the country.

The most significant development in line with the need to integrate services was the transfer to the Division of the Library Section (with effect from January 1st 1988) from the Schools Division of the Ministry of Education. The prime objective again relates to the coordination of the educational resource centres set-up at State, District and School levels. Thus the idea for resources centres has had a pervading and interesting impact on the organisation of educational technology support.

The Library section among other activities is involved in:

a. *evaluation and selection of supplementary reading materials for Schools and reference books for District Resource Centres (another project being implemented through a loan from World Bank).*

b. *Printing of guide books on subjects such as management of school Resource Centres, book selection and development policy for schools and other educational institutions.*

c. *Printing of the* Educational Technology Bulletin *and other special publications.*

d. *Conducting of courses/workshops/seminars for teachers, resource personnel, students, parents and others relating to reading and organisation of resource centres. (Abdul Hamid bin Ayob, 1989, p19)*

The introduction of the KBSR (The common curriculum in schools) in 1983 may be said to have strongly influenced the various agencies to review and reassess their aims, roles and functions. The Library Services unit of the Schools Division and the Educational Media Services Division were no exception. Starting from the 1960's and up until the 1980's library services and media services developed as two distinct entities, though each had the same target group.

What may be termed a shift in emphasis from the preoccupation with the production of radio/TV programs and the provision of library books and non-electronic AV materials to a concern over the concerted use of media (print and non-print) to enhance the quality of education may be dated from the launching of the 'Projek Menggalakkan Penngunaan Perpustakaan Sekolah' (Project to Encourage Intensive Use of School Libraries) in 1981 In that year the Ministry set aside M$409,000 for a three year period during which 25 rural primary schools selected from the 14 states were given guidance, training, encouragement, and assistance to integrate book and non-book materials and look upon them as teaching-learning aids. Initial emphasis of this project was the physical organisation of material according to the established school library system. The rationale here was that systematic organisation of book and non—book materials would lead to easy retrieval which in turn would encourage frequent useage.

The Ministry of Education has embarked on a nationwide strategy towards setting up resource centres at State and District levels. Four State Resource Centres have been established in the rural states of Kelantan, Trengganu, Pahang and Kedah as a pilot project (Tow & Zubir, 1985). Under the current Eighth World Bank Loan Scheme, 360 new District Resource Centres are being built and equipped.

These state and district resource centres will operate in the context of the following functions:

1 *to act as a catalyst towards overall professional development of teachers, particularly professionalism in pedagogy.*

2 *to provide in-service training and guidance to teachers in materials production techniques.*

3 *to act as a materials bank to which teachers can contribute what they have developed either at the school level or at the resource centre itself and from where they can obtain model materials for reproduction and production equipment like cameras, video or audio recording facilities, etc. for self-production of materials for use at the school level.*

4 *to assist teachers, through in-service courses and informal meetings, in acquiring skills of organising and managing their book and non-book materials more systematically at the school level, for easy retrieval.*

5 *to help heighten current awareness of teachers through newsletters and other extension services by keeping them up-to-date on the state of the art in materials production, organisation and use.*

6 *to offer on the spot professional advice to teachers in the course of visits to school resource centres. (Abdul Hamid bin Ayob, 1989, p22–23)*

Be this as it may, the issues confronting the Ministry of Education now go further than the establishment of the school Resource Centres. The 1990s have to ensure the greater use of resource centres by teachers and students, for whole-class teaching as well as individualised learning including self-instruction. There has to be an increase in the understanding of resource-based learning and this will have to be linked to an increase in the use of communication and information technologies including, of course the use of computers in education.

Training in Educational Technology

There are a number of institutions which train teachers. The most easily accessed figures are provided by the Universities (currently six in all). Training of preservice teachers usually includes one or two units in the use of educational technologies. From the figures, it is also evident that the teaching of the students is not also personalised and from experience large numbers of students are required to take educational technology courses.

Univer-sity	Type of Course	No hours/ units	No students	Staff/ Student Ratio
UKM	Elective	2 units	260	1:8
UPM	Core	3 units	1200	1:40
USM	Core	3 units	1363	1:40
UM	Elective	1 unit	380	1:4
UTM	Elective	2 units	800	1:53

(Thanby Subahan & Abdul Mutalib Rani, 1985, pp180, 187)

Linking educational technology concepts with professional development

Interestingly, the development of the resource centre concept has provided an indirect boon for the professional development of teachers. Not only have they provided the technological resources, but they have provided a meeting ground and a link with otherwise different serving agencies. The use of open learning approaches is now being tried to reduce the problems of travel and time away from the classroom. While not universally accepted, the method has significantly helped to improve teacher skills (Dhamotharan, 1990). Even with this newer approach to delivery, there are real problems of participation and the recommendation was that Ministry of Education should support the costs of teachers engaging in this form of professional development.

The concepts for the design and development of alternative delivery systems are similar to those found in other countries, namely, relevance, benefit in terms of time invested, individualisation in terms of needs and feedback, and self-assessment (Dhamotharan, 1990, p 15). A simple comparison with an Australian study has found similar problems in working with teachers for their own professional development (Hedberg & McNamara, 1990). The general applicability of the open learning method is without doubt, the problem remains as to how to motivate teachers who feel that their employer should foot the bill as they believe they undertake the exercise for their employer rather than themselves.

Creating a Professional Associa'.on

Three years ago the Malaysian Educational Technology Society (Persatuan Teknologi Pendidikan Malaysia—PTPM) was formed and the current membership of around 330 people is remarkably healthy. There is considerable support from the Ministry of Education, with time release for teachers and financial support for the activities. The need to develop such an Association is a mark of the growing need for professional recognition of the role educational technology is playing in both the resource centre concept and in the changing resources available to schools.

Changing teaching strategies

Rohanna Zubir has been working and reporting a variety of studies related to the changing use of independent learning versus presentation strategies such as lecturing (see for example, Zubir, 1988). In this regard, Malaysia is facing similar problems to those faced by other countries when the ideas of changing teaching methods. Other authors have also suggested methods which have been tried in other countries such as the audio-tutorial approach (Bujang & Hussain, 1985) but these appear to most often be experiments and not really integrate into the mainstream, largely because of resources available.

Recently, there have been policy changes which suggest that students throughout their secondary school and tertiary studies should be able to also speak another language fluently. The emphasis on English as a second language will have considerable impact on the use of one of the most prized resources—library books. Most universities have considerable collections of works in English. It is to be expected that the focus on learning to read and speak in English as well as Bahasa Malaysia will open up the resources to many students who cannot currently use the resources. The class sizes remain high and so it is unlikely and the staff are relatively inexperienced so that major innovations in teaching methods will not be a likely as the use of the simple resources of teaching, such as books, overheads and presentation.

Increasingly sophisticated concepts of Information Technology

Another idea which was brought home to me with the recent conference was the importance of preparation for life in an information age. The predominant focus in schools has been the acquiring of knowledge to pass the examinations. With growing awareness of resource based learning, there is now a call for the development of information retrieval and research skills (Vias, 1990). In fact this has been a theme of the Educational Technology Division in recent years (Abdul Hamid bin Ayob, 1989) as it encourages teachers to use the broadcast, and audiovisual materials developed by the different sections of the Ministry.

It is this change in the concept of how schools perform their key function of educating the society that educational technology is seen as a key player. The tangible development of resource centres has a clear impact on the presence of educational technology in learning. The organisational links between, print, broadcast, computers and other media forms has therefore potential for efficient development and less fragmented allocation of development effort.

Conclusions

In summarising the current status of educational technology in three developing countries, Don Ely claimed:

1 *Educational technology is more of a movement than a field.*

2 *Efforts to transfer North American technology are resisted, especially in Latin America.*

3 *Educational technology professions exist in all three countries, but they have different titles. (ie Minister of Education, Director of Education, etc.).*

4 *There are existing networks of people: Prof.Assoc.of Ed.Tech. in Chile; National. meeting of educational technology professionals in Indonesia.*

5 *Reasons for acceptance of ed tech:*

- *Leadership (commitment to do something about educational technology);*
- *Principles and practices of educational technology can provide equal access to educational opportunity using media and;*
- *Perception of modernization—a desire to adopt contemporary technologies.*

(Ely, 1990, p1)

Malaysia by comparison has a strong belief in the role technology can play in teaching and learning. There is concern for what should be the main focus in the country and how is should be most effectively employed. This has been achieved by the resource centre concept and its many ramifications for converging services. The development of an integrated organisational structure is by far the most interesting outcome. The task of using it effectively has yet to be proven as the marriage is only two years old.

The changing policy of the government to the use of languages has a bearing on the use of technologies, there is more emphasis now in bilingualism — meaning Bahasa Malaysia and English, in that order and that will develop an increase in the use of the current resources such as books and English language materials.

Clem Chow (1990, p3) in reporting his perceptions of the use of new technologies in developing countries reported:

> *There have been many reports of failures in adapting these technologies. Hardware is relatively easy to get, as is technical assistance compared to help developing appropriate software. To develop successful software, it is essential that there be local input. The material must reflect the values of the particular culture.*

Malaysia has indeed worked hard to provide teaching and learning materials with an appropriate national and cultural bias. The growing sophistication of production methods and quality of materials promises to assist the country achieve better educational methods and more enlightened practice. There appears to be a real movement away from the 'cargo cult' approach to the use of technologies toward an assessment of appropriateness and ease of implementation within the structures provided for dissemination. The unique mixtures are paying off and the growing professionalism of a group who are identifying themselves as educational technologists and who achieve national recognition is an important development.

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Developing an intelligent tutoring system

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This paper is concerned with the development of an Intelligent Tutoring System for use in teaching mathematics. Research in the field of intelligent tutoring systems is generally conducted by cognitive scientists or computer scientists whose main concern is the development of a system that emulates human behaviour, or at least a system that arrives at the same conclusions achieved by a human. This paper takes the view that fundamental to the development of intelligent tutoring systems is an understanding of processes related to pedagogy and learning. That is, this paper argues that the extent to which an intelligent tutoring system is educationally valuable partly depends on the ability of cognitive scientists and computer experts, but also depends on a detailed understanding of the teaching-learning process. In particular this paper examines the intricacies and complexities of teaching and learning seemingly simple mathematical procedures.

The issues

The first decision in developing an intelligent tutoring system is to select the content area. In the research reported here the topics were the addition and subtraction of whole numbers, and the addition of fractions. Educational objectives of the intelligent tutoring system are then set: in mathematics education there has been a long standing argument about teaching for understanding, and about procedural and conceptual knowledge. The intelligent tutoring system must take these views into account in its objectives and in its presentation. Developers of the intelligent tutoring system need then to examine research as to what is known about student learning in that field, including the problem of representing mathematical concepts using two and three dimensional objects, and must then investigate good teaching practice in the field. Each of these issues is analysed in later sections of this paper.

Understanding as an objective in mathematics teaching

Much research and development has taken place in recent years concerning the teaching and learning of mathematics. There is a long history of mathematics taught as a set of rules to be learned and practised. The rejection of this very traditional approach to mathematics also has a long history (Breslich, 1933; Durell, 1929; Taylor, 1938). Contemporary approaches to the teaching of mathematics see 'understanding' of mathematics by the learner as fundamental to the teaching process.

The term 'understanding' reflects at least two views. One view is that of understanding as 'remembering the step by step application of the appropriate rule to obtain the correct answer'. This has its basis in traditional classroom teaching, with the learner simply being a smaller version of an adult, who has to learn the rules of mathematics. A second view of 'understanding' in mathematics is that the learner is able to perform the step by step sequence to achieve the correct answer because he or she understands the concepts behind the rules and has a good knowledge of the relationship between these steps.

Procedural and conceptual knowledge

Procedural knowledge is concerned with following the appropriate sequence of steps to obtain a correct answer, whereas conceptual knowledge requires both an ability to obtain the correct answer and to be able to explain why the steps in the algorith are appropriate (Hiebert, 1986). Learning procedures 'by heart' so as to obtain a correct answer without any deeper understanding is clearly rote learning, and involves only procedural knowledge. That is, procedural approaches involve choosing the correct rule and substituting known values so as to find the value of the unknown: success is heavily dependent on the context in which learning occurred.

Procedural knowledge is concerned with 'how do I get the correct answer?', and is often linked to 'skills', at the expense of understanding. It is seen by mathematics educators as the poor cousin of conceptual understanding. There is a long history of teachers arguing that by teaching 'the skills' a fuller understanding will occur at a later time. This may indeed be the case, but it rarely happens unless the teacher sets out consciously to provide that elaboration of the skill at a later date. In reality, for the great majority of school children, a fuller understanding of mathematical relationships does not occur through drill and practice alone.

Conceptual knowledge involves understanding relationships between concepts and procedures. A student with conceptual knowledge of a topic is more likely to be able to explain his or her solution to a problem, is more likely to have an individual approach to the solution to particular problem, and is more likely to be able to transfer this knowledge to related problems, than is a student who is limited to procedural knowledge. The learner with conceptual knowledge has a well developed conceptual map of the interrelatedness of mathematical ideas, and a well developed network of mathematical concepts. Of course, a student may have conceptual knowledge in some topics, and operate with procedural knowledge in other areas of mathematics.

Conceptual knowledge may be seen to exist at a number of levels. The primary level is where mathematical relationships are understood and can be applied effectively: for example, recognising the appropriate trigonometrical ratio to find an angle in a right angled triangle. Then there is a higher, more reflective level where one sees the relationship that exists between trigonometrical ratios and algebraic statements and manipulations in general. That is, at the higher level, the mathematical understandings are richer, and one can analyse problems to plan the most appropriate method of attack based on earlier experiences and examination of the likely range of possibilities. The essential element to conceptual understanding of mathematics, at both the primary and higher levels, is the understanding of the relationships between mathematical concepts, and the ability to be able to free the mathematical concepts and procedures from the context in which they were actually used; that is, to increase the generalisability of the concepts to new contexts. Von Glaserfeld (1987) argues that the more abstract the concepts and operations, the more reflective activity will be needed, that these operations and concepts are products of several levels of abstractions, and that successive acts of reflection are necessary.

The assumption is made implicitly, if not explicitly, that school mathematics should be about the conceptual understanding of mathematics. Procedural understandings are insufficient. Given the meaning of 'understanding' in contemporary mathematics education, it appears that learners must attain conceptual knowledge in the field of study. Conceptual knowledge is argued to be 'better' than procedural knowledge because it involves a higher level of understanding. In conceptual knowledge the problem solver is more likely to be able to solve a novel question through his or her more fully developed cognitive schema, and through a greater likelihood of being able to successfully transfer previous experience to new situations. Von Glaserfeld (1987) asserts that "the primary goal of mathematics instruction has to be the student's conscious understanding of what he or she is doing and why it is being done". Conceptual knowledge will allow the learner to organise his or her knowledge more effectively, and memory and recall will be easier, because the relationships between the mathematical concepts are understood.

If intelligent tutoring systems are to be developed for widespread classroom use in mathematics the argument of procedural versus conceptual have to be addressed. Indeed, the longer term value of such intelligent tutoring systems is likely to be enhanced if they are based on approaches more likely to lead to conceptual understandings than if they limit themselves to emphasising procedures.

The role of embodiments in mathematics learning

This use of representations in mathematics, especially through the widespread classroom use of manipulative materials, exemplifies one of the major aspects of modern mathematical pedagogy. This aspect is concerned with the representation of mathematical concepts and principles through two or three dimensional diagrams and structures. The main questions of interest to researchers include what representations are most effective in mathematics, ought these representations differ with the age of students being taught, and just how is it that learners use these representations to internalise the mathematical concepts involved so that they construct cognitively efficient inter-related conceptualisations of mathematical knowledge? The term most associated with these aspects of teaching and learning in today's literature is 'embodiments'.

The ways in which conceptual knowledge and procedural knowledge are developed is still the subject of research. It is not a simple issue. Many teachers, especially of elementary school mathematics, make use of teaching materials that embody mathematical ideas. The learner is meant to use this material initially to solve mathematical questions, and then in some way to internalise the mathematical concept embodied in the material. For example, by using Multi-based

Arithmetic Blocks the learner is expected to internalise the concept of place value which causes so much difficulty in the performance of arithmetic calculations. The same materials are designed to help the learner understand addition and subtraction algorithms involving almost any size numbers. But just how the concept of place value or the structure of the algorithm is internalised is unclear. Little detailed understanding exists as to the use of embodiments and symbolisations in general (Kaput, 1987): in spite of research into different representations of a range of mathematical concepts there is no systematic agreed upon theory.

A fully developed understanding of a concept means that the student will be able to use manipulative materials and diagrams to solve problems about this concept, will be able to use spoken and written language to solve problems and describe their solutions, and will be able to apply this problem solving ability to the real world (Lesh et al., 1987): effective teaching will have to include all these kinds of experiences. This idea is supported by Booker et al. (1980) who argue that arithmetic activities ought not to be limited to written numerals, but ought also to include activities associated with the word name and activities involving concrete/ diagramatic representations of numbers. This is clearly important for developers of intelligent tutoring systems.

Present day educational computer software available for use in mathematics sometimes uses diagramatic representations, but relies mostly on written symbols (numerals) and seldom uses number names. Such software may use diagramatic representations of manipulative materials, but the link to written or other symbolisms is rarely apparent. At the same time it must be realised that learners have to be given time to familiarise themselves with the various representations in order to be able to use them effectively, and to have a greater chance of internalising the concepts involved. For example, even calculators are a hindrance in solving arithmetic problems if the user is not totally familiar with the operation of the calculator (Cooper and Hall, 1989).

Dufour-Janvier et al. (1987) add further support to the earlier views expressed here, when they outline a range of motives for using 'embodiments', or as they called them 'external representations'. In their view representations are an inherent part of mathematics, they make possible multiple embodiments of a single concept, they help overcome specific difficulties and make mathematics more attractive and interesting.

With regard to intelligent tutoring systems then, there is a clear need to emphasise the flexibility with which such systems must deal with representations of mathematical concepts. This need for flexible representations is likely to increase in importance as the availability of mathematics education software, including intelligent tutoring systems, increases.

Teaching strategies

The importance of the way mathematical concepts are represented has been discussed, as have the kinds of knowledge learners' need to achieve. But there is still the issue of teaching strategies. That is, conceptual knowledge may be more desirable than procedural knowledge, and embodiments used in computer based teaching may have to be flexible, but this does not solve the problem of how topics should be taught.

The question of the most effective teaching style is clearly complex. The behaviourist style of teaching with its emphasis on stimulus-response connections is eliminated since mathematics educators generally regard it as unpopular and believe it is likely to lead to procedural rather than conceptual knowledge. According to Howson (1983) this approach has exerted little influence on mathematics teaching.

The Integrated-Environmentalist style (where mathematics teaching is environmentally based) and the Formative teaching style (based on Piagetian principles) would seem to be too complex in terms of design and construction for use in an intelligent tutoring system, and in any event there is little support for them in the schools (Howson, 1983). The Structuralist approach, emphasising the structure of mathematics, seems to have a good deal in common with the design and structure of an intelligent tutoring system. Howson notes that there has been little rigorous research into this teaching style, but argues that it is a useful approach. Indeed there is a good deal of support in the literature for the Structuralist approach to teaching mathematics (Booker et al., 1980; Bruner, 1963; Dienes, 1960, 1973).

A pedagogical model for mathematics teaching

In mathematics education the acquisition of conceptual knowledge is believed to be facilitated through the use of manipulative materials. 'Embodiments' are an important part of mathematical pedagogy (Booker et al., 1980; Davis, 1986; Hall, 1981a, 1981b, 1982). More recently there has been a closer examination of these assumptions so as to understand how learning actually takes place, how concepts are formed and organised, how efficient cognitive networks are developed, and how concepts can best be stored and retrieved. In developing an intelligent tutoring system it must be remembered that we are primarily concerned with the view of 'embodiments' as a teaching methodology: but this more recent research emphasis into how learning actually occurs through the use of 'embodiments' provides us with a model upon which to base pedagogy.

Ohlsson and Hall (1990) have developed a model that predicts that the pedagogical effectiveness of an embodiment is a function of four variables: the ease with which the learner can understand the description of the embodiment procedure, the ease with which that description can be proceduralized, the degree of isomorphism between the embodiment procedure and the intermediate or target procedure, and the degree to which the transformation of the embodiment procedure procedure into the intermediate or target procedure can be done through simplifications.

The model focusses on the isomorphism between the embodiment procedure and the intermediate or final target procedure. This model proceeds in four steps:

a Construct an information processing model of the embodiment procedure as well as the target procedure.

b Run the models to generate expanded traces.

c Decide which entries in the expanded traces correspond to each other.

d Calculate the isomorphism index.

Figure 1 shows an expanded trace for the use of Multi-based Arithmetic Blocks in solving an addition of two three-digit numbers. In the figure F, L and U represent Flats, Longs and Units which are the names given to the materials to emphasise the place values hundreds, tens and units.

Figure 1: The procedure for addition with MAB blocks.

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0. Add (5F, 3L, 2U) and (1F, 4L, 9U).

1. Process the units (2U, 9U).

- *1.1 Join 2U to 9U => 11U.*
- *1.2 Trade 11U.*
  - *1.2.1 Decompose 11U.*
    - *1.2.1.1 Count out 10 units.*
    - *1.2.1.1 Move remaining 1 unit down.*
  - *1.2.2 Exchange 10 units.*
    - *1.2.2.1 Move 10 units to the bank.*
    - *1.2.2.1 Move 1 long to the L column.*

2. Process the longs (3L, 4L, 1L).

- *2.1 Join 3L to 4L => 7L.*
- *2.2 Join 7L to 1L => 8L.*
- *2.3 Move 8L down.*

3. Process the flats (5F, 1F).

- *3.1 Join 5F to 1F => 6F*
- *3.2 Move 6F down*

Total number of enties: 17.

There are seventeen steps that the learner must take in order to answer this question. Some of the steps are physical actions but others are thought processes. Next another trace is devised, for example, a trace of an 'expert' in adding three-digit numbers: this is the target procedure. The steps in the embodiment procedure are compared with the steps in the target procedure. A measure of the isomorphism between the two procedures is calculated using a formula that takes into account the number of steps in each trace, and the number of steps in one trace not matched by steps in the other trace. Ohlsson and Hall (1990) maintain that the higher the isomorphism as calculated using the formula, the more effective will be the use of the embodiment in teaching the target behaviour. Put another way, the higher the measure of isomorphism, the greater will be the achievement scores of learners. This formula was successfully applied to three pieces of research, two of which were computer based.

To generate sets of production rules for these procedures takes a matter of hours. The ease with which the measure can be applied makes it possible to generate hypothetical designs, calculate how well they come out on the isomorphism index, revise them, calculate the index again. The model claims that the degree of isomorphism is one of four variables that determine the effectiveness of an embodiment. It is not the sole determinant, but the researchers suggest that it is safe to predict that if the isomorphism is low, then the embodiment will not be effective.

According to this model the teacher has three tasks. First, to describe the embodiment procedure in such a way that the learner can proceduralize it. Second, to specify the analogical mapping between the embodiment procedure and the intermediate procedure. Third, to guide the learner through the successive simplifications of the intermediate procedure until it coincides with the target procedure. In the context of intelligent tutoring systems, the designers of such systems may find this model an appropriate base from which to develop specifications for the system. In any event the model proposed by Ohlsson and Hall clearly shows the complexity of having students learn mathematical concepts and skills, and indicates that specifying the teaching component of an intelligent tutoring system will itself be a complex problem.

Conclusion

Inherent in this paper is the view that intelligent tutoring systems will lessen their potential impact if their designers believe that knowledge is a commodity, directly transferable from one person to another in the way that everyday items are bought and sold. The software's role is not to dispense knowledge in accurately sized dollops, but to provide the opportunity for the learner to come to a correct and efficient conceptual organisation. This paper has argued that in the world of classrooms, education and training the development of an intelligent tutoring system is indeed problematic.

The Ohlson and Hall model summarised here addresses the major issues raised in this paper. The model describes a method for using embodiments in both face-to-face and computer based teaching, it provides a pedagogy based on a well documented view of learning and clearly demonstrates a method of assisting a learner towards both expert behaviour and an understanding of mathematical concepts. The model provides a useful tool suitable for the design of the teaching component of intelligent tutoring systems.

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Expert systems and education: An Innovation in Grad Dip Ed (Computer Education)

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In a continual quest for excellence and application of leading edge technologies, The Institute of Technical and Adult Teacher Education (ITATE) introduced "Expert Systems and Education", as a final semester option, into their Graduate Diploma in Educational Studies (Computer Education) during Semester 2 of 1989.

This paper presents the lecturer's perspective of the inaugural launch, method of presentation, evolution of format, conceptual pitfalls and teaching challenges together with concensus strategies for hurdling foreign jargon, alien methodologies and preconceived mysteries.

Despite unexpected manifestations of seemingly myriad problems, some bizarre computer feedback and tremendous emotional drain in continual attempts at demystification of strange concepts, the author found *Expert Systems and Education* the most difficult, unconventional yet fascinating and rewarding experience in a twenty–five year tertiary teaching career.

The Group of 1989

The inaugural Expert Systems option attracted the majority of teachers, trainers, and educators taking courses in semester 4 of the Grad Dip Ed program. Student backgrounds covered the spectrum: TAFE Computer Co–ordinator, TAFE teachers of Business and Administrative Studies, Engineering, Building, Mathematics, General Studies, External Studies, HSC Chemistry. Primary Education, Teacher Education, Public Service, Computer Industry completed the 1989 cohort.

The lecturer's qualifications range across several disciplines [Electrical Engineering \ Applied Science \ Operations Research \ Computing \ Education], 14 years in industry, 21 years full–time tertiary teaching. He qualified for the Grad Dip Ed (Computer Education) in 1988 with the project ARTIFICIAL INTELLIGENCE — EXPERT SYSTEMS — IMPSHELL and has studied educational techniques during the past 15 years.

Course Outline

Expert Systems and Education seeks to develop an understanding of expert systems and their social and educational implications. Students learn how expert systems work and study samples of expert systems in use. Students also use expert system shells to gain practice in building expert systems in their area of specialisation.

Pre-requisites and Assessment

Pre-requisites consisted of the subjects: Computers and Teaching 1, Information Processing 2 and Principles of Programming 2. Assessment consisted of the creation of individual Expert Systems together with essays detailing the application of Expert Systems in each student's area of expertise.

Objectives

The course unit was designed to enable students to

- critically examine the notion of expert systems
- describe how expert systems work
- explain methods of knowledge acquisition in expert systems
- describe examples of expert systems in use
- use expert system shells to gain practice in building expert systems in their area of specialisation
- discuss the social and educational implications of expert systems.

Content

The content comprised the following topics:

- The human expert. Expert knowledge versus expert behaviour. Components of an expert system.
- How expert systems work. Inference engine. Working memory. Knowledge base. Rules, networks, frames. Backward and forward chaining. Differences among expert systems.
- Methods of knowledge acquisition used in expert systems. Knowledge engineering. Induction and intelligent editing.
- Examples of expert systems, eg, MYCIN (medicine), PROSPECTOR (geology), INTEST (legal), BUILD (architecture), EXCALIBUR, BUGGY, SOPHIE (education).
- Expert system shells. Expert systems versus expert system shells. Variety of expert system shells. Advantages and disadvantages of using expert system shells. Using an expert systems shell to develop a proposed expert system.
- Social and educational implications. Deskilling of professional knowledge and expertise. Wider availability of expertise. Expert systems as expert teachers. The effects of the narrow domain of expertise of expert systems.

Resources

The ITATE Computer Studies Unit comprises a laboratory of 24 IBM work stations together with a laboratory of 14 Osborne work stations. The two contact hours per week were scheduled for Wednesdays, 11.00 am to 1.00 pm in the IBM laboratory. The IBM machines allocated for the course were of the PS/2 System 30 286 variety.

Available software consisted of ESIE and IMPSHELL-87 Shareware Expert Systems Environments, evaluated by two ITATE students in partial fulfilment of requirements for the award of Grad Dip Ed (Computer Education). Every other resource had to be begged or borrowed. For example, IMPSHELL-89 was begged, while EXPERTEACH III was borrowed.

Documentation for IMPSHELL was finally published in text book form and became available in Australia during April, 1989. The book Expert Systems Programming in TURBO PROLOG, Daniel H Marcellus, Prentice-Hall Inc 1989, which included IMPSHELL-89 diskette, was used as a primary reference for *Expert Systems and Education*. In addition, the impressive On-line Study Course, EXPERTEACH III, IntelligenceWare Inc., 1988, was introduced, for consolidation purposes, as a self-paced tutorial.

Under the prevailing conditions, one's teaching ability and use of inner resources, guided the direction of the course and proved the main contributing factor to the degree of success of *Expert Systems and Education*. The author was prepared to face peer and student judgment at the end of the inaugural course during December, 1989.

Philosophy of Presentation

The initial design was generally in accordance with most of the *Background Assumptions* presented in Adult Learning Principles and their Application to Program Planning, D H Brundage & D Mackeracher, 1980. The detailed lecture notes endeavoured to sequence the course in small, easily digestible, visual frames. It was anticipated that the proposed technique would give each student a "feel" for Expert Systems without wading through a near infinite jungle of foreign jargon. The KISS (Keep It Supremely Simple) principle governed the method of presentation.

Essentially, this course was designed for maximum effect. It would demystify Expert Systems and explore the depth as well as breadth of the topic in a graphic, diagrammatic, jargon-free mode. The group would focus on understanding, creating, achieving and evaluating, rather than arguing about shades of meaning in a large vocabluary of strange nomenclature. In the words of Anna Hart, Knowledge Acquisition for Expert Systems, Kogan Page, 1989:

> *a no-nonsense approach to a subject which is too often obfuscated by jargon and technicalities.*

Inaugural Lecture

The first lecture was carefully prepared on several overhead transparencies and commenced with a short introductory overview. The field of Expert Systems was defined as a subset of Artificial Intelligence(AI). IBM PC based expert systems shells were introduced, together with previous work in this area at ITATE. The class was alerted to unconventional AI jargon and was led through a hands-on demonstration of EXPERTEACH III.

Assessment tasks were presented together with the notion that the group would be studying an emerging body of knowledge. The introductory phase concluded with some suggested areas of research and the presentation of a substantial list of reference books.

Expert Systems demystification commenced with individual student participation in hands-on attempts to solve the classic, four coin, nickel-and-dime problem. After three to four minutes a visual representation of the complete problem space, in traditional state–space decision tree format, was displayed using the overhead projector and a copy was distributed to each student.

The historical perspective took the form of a chronological scan through fifteen important milestones of AI research between 1947 and 1990. Artificial intelligence in education was illustrated by a transparency featuring intelligent computer–assisted instruction (ICAI) placed in context of AI activities and lessons learned during the two decades, 1960–1980.

The basic elements of artificial intelligence were conceptualised in the form of a segmented wheel, each segment representing a unique subset of AI. Expert Systems was highlighted in the transparency. A later transparency illustrated the distinctive similarity between the User — Inference Engine—Working Memory—Knowledge Base Expert System Architecture and Student—Tutor—Prior Knowledge—Knowledge Base, ICAI Educational Model.

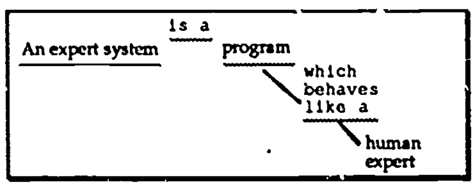
Expert Systems in Management were presented from the point of view of the "Intelligent Assistant" as a facilitator in the decision process. The module concluded with several applications of Expert Systems in Crisis Management.

Overview of Expert Systems

The second session focused on discussions of the following essential questions: What are Expert Systems? Why use them? How do they work? Where are they used? Can they alter society, and in what way? What is their potential, in education and training? What is their potential, generally? What supporting resources are available? What systems are readily available, how effective are they, and how are they programmed?

After approximately 30 minutes, it was time to introduce a change of pace in the form of an exploratory walk-through the various menus plus all frames comprising the introductory Item 0: Background on Expert Systems within the EXPERTEACH III tutorial.

The EXPERTEACH III learning environment posed a series of pertinent questions and provided simple, jargon–free answers, in an impressive colour coordinated graphical format. For example:



EXPERTEACH III thus led the group through Methodologies for Dealing with Knowledge, Knowledge Oriented Applications, Differences Between Traditional Programming Languages and Logical, Object Oriented Programming. The penultimate frame displayed a chronological development of programming languages in block–graphical format. The initial contact with PROLOG and LISP took place in the penultimate frame of Item 0.

The next change of pace was designed to slot the presented terms and concepts into context by conceiving a possible application. A classic mystery "Electronic Expert Solves Murder at Mumfrey Manor" was thus specifically chosen to reinforce the group's interest and to blend the new concepts with previous knowledge.

Secrets of an Electronic Expert

A hypothetical crime-solving expert system, SHERLOCK, was introduced in order to illustrate investigations in a typical Sherlock Holmes mystery. The scene consists of the discovery of a body, six possible murder suspects and a bureaucratic police inspector jumping to hasty conclusions.

SHERLOCK initiates this dialogue, one question per frame:

- Has the Furniture Been Disturbed?
- Except for the Death Wound, Does the Victim have any Marks that Could Have Been Caused by the Attacker?
- The Crime Occured in the Victim's Bedroom?
- The Crime Occured in the Victim's Study? and so on.

Chains of logic, acting on the responses, confirmed the hypothesis that "The Victim Knew and Trusted the Killer". The path to this conclusion traversed intermediate states such as "The Victim Did Not Struggle", "There is No Sign of a Break-in", "The Crime Occured in the Victim's Private Domain". Multiple connections between states feature AND, OR connectors, or entirely separate paths SHERLOCK may be interrogated and each chain of logic reviewed by a WHY? or HOW? response at the point of interest.

Uncertainty

Partial or uncertain information, such as "a smudged fingerprint" or "questionable testimony", is handled by SHERLOCK through the use of "Certainty Factors". Scratches on the victim's hand therefore elicited a response of 0.8 negative (80 percent certain) to the question "Except for the Death Wound, Does the Victim Show any Marks that Could Have Been Caused by the Attacker?". A computed "Certainty Factor", which reflects the combined uncertainty due to dialogue and inbuilt knowledge, is thus returned with the final conclusion.

"Murder at Mumfrey Mannor" clearly illustrates that SHERLOCK, the Electronic Expert, finally unmasked the killer by following a simple chain of logic, not unlike a trail of footprints. Each new step followed on the heels of the last until the destination was reached.

Consolidation

The intuitive ideas, displayed by SHERLOCK, were sequenced diagrammatically on transparencies, formalised, consolidated and generalised by further illustrations. Each transparency emphasised contextual AI analogies of every new concept applied by the Electronic Expert. The structure of SHERLOCK was formalised, facts and rules were emphasised and the "chain of logic" was related to the inverted "search tree". The "root-node", "tree branches", "child-nodes", "depth" and "leaf-nodes" were identified.

Students were familiarised with formal problem representation, consultation paradigms and five strategies for representing knowledge. "Semantic Networks" were thus related to "Object-Attribute-Value Triplets", "Rules", "Frames-Inheritance", "Logical Expressions".

Forward and Backward Chaining was introduced as techniques of "groping for a solution" or "confirmation of hypotheses" respectively. Various search patterns, Exhaustive, Random, Heuristic were illusrated and evaluated. The Animal Classification system was explored within ESIE and "Investment Advisor" within IMPSHELL as hands-on illustrations of the differences between forward and backward chaining respectively.

Evolution of Expert Systems

Having gained an appreciation of the structure and operation of SHERLOCK, ESIE, IMPSHELL, generality was introduced by an examination of the evolution of expert systems within the wider framework of AI development. All essential information was again encapsulated in graphical form on several transparencies. On a time-scale from 1940 to 1990 plus one may thus trace the myriad development paths, such as Formal Logic, Symbolic Computing Systems, Applied Artificial Intelligence, Expert Systems, Expert System Building Tools, Large Hybrid Systems, Intelligent Tutoring Systems. Evolution of Expert Systems was illustrated in the now familiar inverted tree structure, with DENDRAL, MACSYMA, MYCIN at the root and later applications, INTELLECT, HASP, PROSPECTOR, XCON, PUFF, and so on, at the next level of development.

The perceived future of Expert Systems was illustrated in the form of two waves. The first, smaller wave, is generally predicted to crest at the present time, while the second, much larger wave, is just beginning to swell and is not expected to crest until 1992 to 1995. The second wave is expected to have a significant impact on business and industry.

Expert System Shells

The emphasis next shifted to in-depth exploration of Expert System Shells. The adopted strategy encouraged individual student exploration of the relatively simple PASCAL IF-THEN rule based ESIE, in parallel with detailed class material on the "fuzzy-logic" driven, PROLOG style IMPSHELL.

Because IMPSHELL is coded in PROLOG, all students were first familiarised with basic differences between Procedural and Declarative programming styles as two perspectives of the same knowledge. Tracing, checking, editing rules required an exhaustive analysis of the internal, IMPSHELL eight-segment, rule storage format. The rule structure was visually related to simplified real-life situations such as: Transportation Planning, Housing Loan Evaluations, Aircraft Recognition, Management of Minor Ailments.

IMPSHELL Rule Types, Reversibility, Positive, Negative applications, Premises, Conclusion were illustrated in "field-record" file processing format and related to simple examples. AND, OR, and NOT operators were defined within "Crisp Logic" and extended to "Fuzzy Logic".

The MYCIN style confidence (certainty (ct)) representations of "definite", "almost certain", "probably", "slight evidence", "don't know", "practically not", "almost certainly not", "definitely not", were marked on a number line between limits of -1.0 and +1.0. The visual impact of this representation proved to be immediate and total.

Approximate Reasoning

This segment commenced with an assurance to students that fuzzy logic based, multi-stage reasoning operates on a few, relatively simple concepts. It generally avoids the complications associated with Bayesian statistics. Calculations involving degrees of certainty(ct) were thus based on the principles:

- A single piece of evidence in an implication.

  [ct(conclusion) = ct(evidence) * ct(implication)]

- Logical combinations of evidence within a single rule.

  [ct(evid1 AND evid2) = min(ct(evid1),ct(evid2))]

  [ct(evid1 OR evid2) = max(ct(evid1),ct(evid2))]

- Multiple rules supporting the same conclusion.

```
0                        +0.76    +1.0
[-------------------------------------]
  (First Conclusion  .6) ^    ^
                         0    ^   +1.0
                         [-----------]
   (Second Conclusion  .4) ^
```

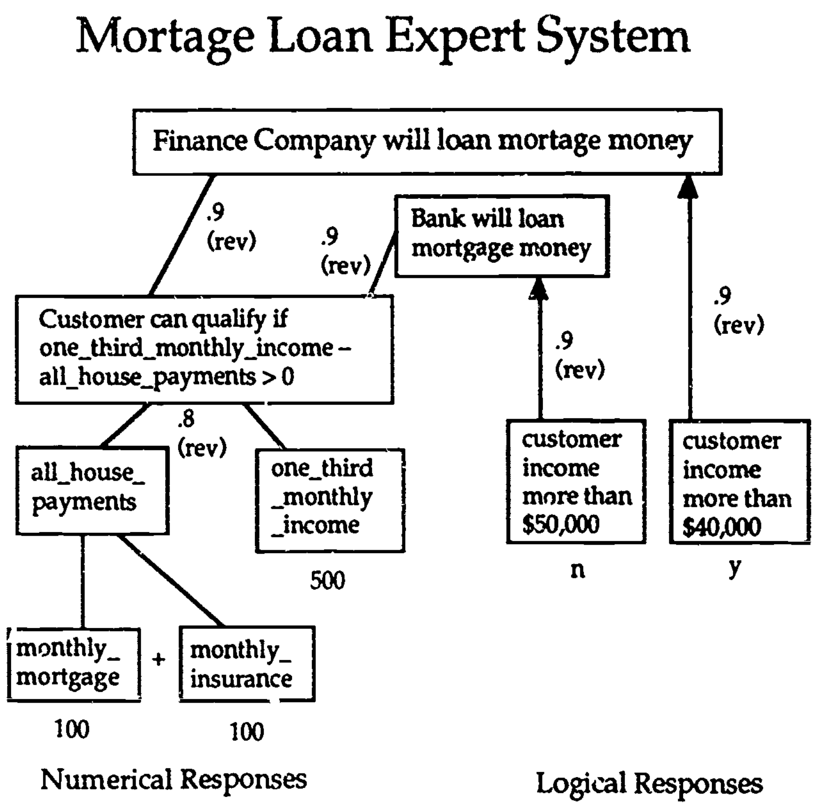
- Bipolar certainty figures (ct1 = +ve, ct2 = -ve)

  [ctotal = (ct1 + ct2)/(1 - min(abs(ct1),abs(ct2)))]

AND implications were therefore viewed as the weakest links in a chain of logic, whereas OR implications were considered to represented its strongest links. Extensive certainty calculations were avoided by providing each student with tabulated bipolar conclusions.

Equivalence between "Inference Net Notation" and "Rule Notation" was highlighted on a transparency and immediately interconnected, coded and saved within IMPSHELL as a "Medical Rule" (MEDICAL.RUL) inference net. Hand calculations were performed on MEDICAL.RUL inference net for several sets of client responses and compared with results returned by IMPSHELL. Similar tests were carried out for a Mortgage Loan example and on FUZZYNET, an inference network especially constructed to reason about competing hypotheses.

Hand calculations were applied to the substantial, 25 question — 6 Hypothesis, "Investment Advisor" supplied on the IMPSHELL-89 disk. A comparison with results returned by the Expert System disclosed a discrepancy in the degree of certainty in one of the six Investment Hypotheses. A careful examination revealed a missing full-stop (.) in a single statement within the IMPSHELL knowledge base. The IMPSHELL environment was particularly unforgiving but our methodology withstood the acid test.



Logical—Numeric Interface

Expert Systems dialog generally requires answers to some questions in the form of certainty factors, while other responses, such as "monthly_mortgage", within the MORTGAGE LOAN EXPERT SYSTEM, require numerical inputs. Eventually an expert system must reconcile the two forms of responses, both of which invariably contribute to the displayed conclusion. Consider the mixed mode in the diagram.

The simple inference net discloses that numerical and logical inferences converge at the two concluding nodes and have to be reconciled at both locations.

IMPSHELL is designed to manipulate algebraic expressions by conversion to Reverse Polish Notation (RPN) and returning a TRUE(+1) or FALSE(-1) result by an embedded RPN interpreter. This aspect was thoroughly tested and extended by introducing the group to the PROLOG environment, and in particular, PROLOG-C, PROLOG-PASCAL project modules. System execution traces were often saved and evaluated as aids for error diagnosis.

The main segments of IMPSHELL were interpreted in PROLOG source code and a small test program FUZZYNET was executed using standard PROLOG and within the IMPSHELL environment. Both results were verified by hand calculation. The group was introduced to the inbuilt

WHY and HOW capabilities and a detailed exploration of the WHY stack was undertaken. The HOW function did not appear to operate within IMPSHELL-89.

Creation of New Expert Systems

The numerous concepts, covered by the course, were now focused on narrow, specialised domains and combined into the design of several semantic nets, which were analysed by hand calculation and verified by IMPSHELL. Group confidence increased dramatically after several successive matches with IMPSHELL.

The prelude for individual student project work consisted of a detailed tour through the Expert System Creation Sequence. The mode of presentation consisted of successive computer screen dumps transposed on transparencies. The creation diologue was emphasised and applied to a small example.

Knowledge Acquisition

The closing sessions of the course focused on Knowledge Acquisition, Computer Learning, Relational Databases, Hypercard/Hypermedia and their possible applications in the educational environment. Substantial programming code was examined to illustrate Arthur Samuel's game playing algorithms, a program which learns to differentiate between a number of different objects and Hypermedia as a possible link between Expert Systems and Computer Aided Learning.

Students were acquainted with current activity in Expert Systems applications. These included PICON, PREDICTE, WES, APES, CLASS, JET-X, CARE, ROSES, ECAS together with a brief description of the commercial shell NEXPERT. Current openings for Artificial Intelligence and Expert Systems professionals were mentioned.

Student Perceptions

After establishing interconnecting nodes and defining the backward chaining process with a flow chart it seemed like an easy task.

Could anything be more straight foreward than this backward thinking?.

I found the development of my own non expert 'expert system' a time consuming but very rewarding exercise.

I entered 'you have tender abdomen' in my implication statement instead of 'you have a tender abdomen'. The result of this was that in the printout of the 'inference summary' statements beginning with db occured which I could not understand.

Resolved Mysteries

The IMPSHELL expert systems rule set is usually quite straight forward in the "pre-run" mode. Logical implications consist of interconnections of "terminal_node" (question), "imp" (implication) and "hypothesis_node" (hypothesis).

The "post-run" rule set, however, is typically much longer. Additional information, provided by the system, consists of evidence, "infer_summary", "danswer" together with equivalent terms for mathematical implications.

These extra terms establish a trace and display IMPSHELL certainty calculations at all nodes.

There are no traditional diagnostic messages. Character mismatches, however, appear to be indicated by "dbimp" from the WHY stack and the undefined "tdbimp" statements in the "post-run" rule set. Hypotheses, which exclude contributions from mismatched paths, are evaluated by IMPSHELL.

Student Projects

Some impressive Expert Systems, created by students within the IMPSHELL environment, ranged through the fields of TOURISM, AUTO-MECHANICS, NATURAL-MEDICATION, FAULT DIAGNOSIS, VOCATION PLANNING, ILLNESS DETECTION, STUDENT SELECTION, PURCHASING, DOCUMENT PREPARATION and CARBON CHEMISTRY.

Student essays, designed to broaden their knowledge of applications, featured the following titles :

- Expert Systems in Education and Other Domains.
- Perceived Future of Expert Systems.
- The Threat of Thinking Machines.
- Talk Plain With an Expert.
- Robotics, Natural Language and Expert Systems.
- Commercial Applications of Expert Systems.
- ESIE Expert Systems Inference Engine.
- The Credentials of DENDRAL and MYCIN.
- In Depth Exploration of Expert Systems Shells.
- Animals Within ESIE.
- Knowledge Representation in Expert Systems.

Conclusion

Following a review of *Expert Systems and Education* plus suggested future directions for each of the participants the group reflected on the learning experiences during the allocated 30 hour course. It became apparent that inovative teaching techniques and excellent group dynamics played important roles in the learning process.

The author was amazed by the rate of progress during the 15 week course. Course content was exceeded while most assessment tasks were original and of exceptional quality. It appears that the extensive coverage was possible by continual application of the Confucian Dictum — "one picture is worth a thousand words". Top priority was given to "what it is" rather than "how you say it".

The style of presentation was adaptive to student needs and aspirations. Group dynamics influenced the agenda for each session. The numerous books, journals, articles, consulted by the group makes a bibliography impractical. However, books by Anna Hart, Chris Naylor, C.F. Chabris, Harmon and King, P.S. Snell, A.C. Staugaard, W.J. Black, B.G. Silverman, Clocksin and Mellish, V.D. Hunt, D.N. Chorafas, together with ITATE Theses by B.J. Smith and G.I. Gedgovd, were frequently examined by the participants.

In many ways Anna Hart, Knowledge Acquisition for Expert Systems, 1989 summarises the cooperative effort of the ITATE class of 1989 by the following words:

> *I have seen many good projects. They all had somebody in the development team who had a questioning spirit, who was able to take on ideas from different disciplines and who was not afraid to change a decision.*

Despite unconventiality, selective usage of emotions added "enthusiasm", "flair", "a sense of adventure" to a subject "often obfuscated by jargon and technicalities". Perhaps our collective appreciation of the intuitive elegance of AI played a major part in the success of *Expert Systems and Education.*

Recognition of achievements have been swift and positive. One participant has been invited to teach Expert Systems while another intends to pursue the Expert Systems\Computer Aided Learning (CAL) interface to master's level. With gradual resolution of teething problems, acquisition of worked examples plus additional Expert Systems Shells, it is anticipated that the 1990 session will offer a substantial advance on the described course.

Acknowledgements

The author gratefully acknowledges the guidance and advice of the ITATE Computer Coordinator, Mr. John Roc, during the design and presentation of *Expert Systems and Education*. Particular appreciation is expressed to Mr John Roc for his faith in the author's untested ability to teach teachers, trainers and educators. Sometimes faith can indeed move mountains.

A computer-based system for developing expertise in the diagnosis and remediation of common error patterns in the domain of fractions

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In our mathematics education courses at Queensland University of Technology, a significant amount of time is spent in trying to develop high level diagnostic and remediation skills. One method which is used to achieve this aim is to have the student teachers analyse error patterns taken from children's work. This analysis usually proceeds in three phases. First, the student teachers are required to identify the error pattern. Then they are required to identify the underlying causes of the error pattern and state possible reasons for the children's use of the error pattern. Finally, the student teachers are required to plan a sequence of remediation activities which first would help the children understand why their answers were wrong and second would help them learn how to generate correct answers for the problems.

Most student teachers experience few problems with the first phase of the analysis; the identification of the error pattern. They however experience great difficulties with the second and third phases of the analysis; identifying the underlying causes and planning an appropriate sequence of remediation activities. This is not surprising because these two phases of the analysis require the student teachers to do more than just recall information which they have acquired from their mathematics education courses. These two phases in fact require the student teachers to utilize higher level application thinking skills based on accurate observation of working children. Because of this, most of our students tend to utilize a *shotgun* approach in these two phases and thus produce rather inexact and impractical diagnostic and remediation reports. For example, given an error pattern such as that in Figure 1 below, it is not uncommon for student teachers to recommend a remediation program which consists of all the activities which they have recently done in a series of workshops on fraction concepts. That this sequence of activities may cover work to be done over eight years within a school curriculum seems to be overlooked.

$1/3 + 2/3 = 3/6$

$1/4 + 3/4 = 4/8$

$3/5 + 5/8 = 8/13$

Figure 1 An Error Pattern for Addition of Fractions

Unfortunately, at present, the student teachers rarely have an opportunity to implement and evaluate their planned sequences of remediation activities. Many of them thus graduate without realizing the inappropriateness of the *shotgun* approach. This is one reason why most of our graduates exhibit low levels of expertise in diagnosing and remediating mathematical learning problems.

It is in this context that the System for Diagnosis and Remediation of Mathematical Error Patterns is being developed. Unlike many other Computer-based Systems whose major purpose is to replace or supplement human experts, the major aim of this system is to provide the users with experiences which will help them to develop such high levels of expertise, that they soon will no longer be dependent on human and/or computer experts.

In the section that follows, the architecture and the functioning of the system in its present form will be described. Following this, a description of how the system will be used by teacher education students at our college will be presented. In the final section of this paper, future directions for this research and development project will be discussed.

The Present System

During the preparation of the system, a number of assumptions based on close classroom observations and laboratory research were made about how children learn and do mathematics and a number of criteria for an effective system were specified. The assumptions made about how children learn and do mathematics were:

1 that many of the errors that children make in mathematics are systematic, and

2 that the underlying causes of these error patterns are related to the manner in which mathematical knowledge is stored and structured within the children's long term memory.

The criteria for an effective system were:

1 that the system's actions should parallel the actions of real children as closely as possible;

2 that the system should give students easy access to its knowledge base so that they can better understand the underlying causes of why children use error patterns in mathematics;

3 that the system should have psychological validity; and

4 that the domains of knowledge explored by the system should be those in which most children experience difficulties.

One major consequence of these sets of assumptions and criteria has been that the system presently being developed is a network of production systems which focuses on the addition and subtraction of vulgar fractions with unlike denominators. Before proceeding on to a description of the system, it first would be desirable to briefly describe what a production system is and how it operates.

Production Systems

Production systems were first employed by Newell & Simon (1972) in order to help in the analysis of detailed protocols of human problem solving behaviour. According to Young, the technique attempts to capture regularities in a subject's behaviour by writing a set of independent rules — known as a production system (PS) — that expresses what the subject does under what conditions (Newell, 1968; Newell & Simon, 1972). Each individual rule (or PR for 'production rule') is a condition action statement of the form C ===> A and means simply that in the circumstances specified by C the subject performs action(s) A. (Young, 1971, p3)

The condition side of a production refers to the symbols in the Short Term Memory (STM) that represent the goals and the elements of knowledge existing in the system's momentary knowledge state. The action consists of transformations such as the generation, interruption and satisfaction of goals, modifications of existing elements and the addition of new elements to the STM.

The architecture of a classical production system (Klahr, Langley and Neches, 1987) is presented in Figure 2 below.

TOTAL SYSTEM

LTM
T1 (Temp < 70) (Furnace off) ===> Turn on Furnace
T2 (Temp > 72) (Furnace on) ===> Turn off Furnace.

STM
(Temp = 71) (Furnace on) AA BB CC

Figure 2 Overall Architecture of a Production System

The STM holds an ordered set of symbolic expressions or chunks. New expressions always enter the STM at the front or left hand end. Thus, when (Temp > 72) enters the STM in Figure 2, the contents of the STM will be:

(Temp > 72) (Temp = 71) (Furnace on) AA BB CC.

The conditions of the production rules examine the expressions in the STM in order starting from the front. Front expressions in the STM thus may preempt later expressions. The LTM consists entirely of an ordered set of production rules. Each production rule is written with the condition on the left separated from the action(s) on the right by an arrow. In Figure 2, only two production rules are shown: T1 and T2.

This particular production system operates a thermostatic control device whose purpose is to keep the temperature of a room between 70-72 degrees Fahrenheit. As the system stands initially, none of the production rules in the LTM is satisfied by the contents of STM and nothing happens. However, as is shown in Figure 2, (Temp > 72) is about to enter the system from the external world. When it does, the contents of the STM will contain the two conditions necessary for the selection and the execution of Rule T2 by the system:

(Temp > 72) and (Furnace on).

The action of Rule T2 will be to turn the furnace off.

In contrast, if the contents of the STM had indicated that the furnace was off and if the incoming information from the external world was:

room temperature less than 70 (Temp < 70), then Rule T1 would have been executed. Its action would be to turn the furnace on and heat up the room.

The Prototype

Although production systems have predominantly been used to analyse adult protocols, production systems have a number of properties which make them most appropriate for the present project of producing a system for the diagnosis and remediation of error patterns associated with the addition and subtraction of fractions with unlike denominators:

1 Production Systems can serve as a miniature Artificial Subject whose reactions to different experimental manipulations can be empirically explored. The production system thus can be used to predict a child's cognitive behaviour under certain conditions much more precisely than with most other techniques.

2 Production Systems analyse problem solving into components which specify not only what a child does but also when he (or she) does it. Most techniques, such as Gagne's technique of task analysis (Gagne, 1962, 1968) and Pascual-Leone's technique of M-Space analysis, only indicate what the child does. The solution of a problem, however, involves more than the simple linking together of a list of sub–tasks. Information about when and how these sub–tasks are linked together is just as important. This capability of production systems to specify what the child does, when s/he does it and how the child does it is therefore most useful when one is trying to develop a complete processing model.

3 The explicit control structure of a Production System makes clear exactly which decisions the child has control over and which decisions are forced on him or her by the environment. Production Systems thus allow one to clearly indicate how the child's goals affect performance on a task. With many other techniques, this is well nigh impossible especially if one tries to simultaneously indicate how environmental factors may have affected performance.

4 Production Systems can cope with minor variations to a Task. This enables construction of a single processing system to handle all variations of the addition and subtraction of fractions tasks rather than the construction of separate systems for each variation of the tasks as has to be done with most other techniques such as flow-chart and M-Space analyses (Pascual-Leone, 1970).

5 Production Systems are the most homogeneous form of programming organization known to man (Newell & Simon, 1972). Each production rule represents a fragment of potential activity that is a meaningful component of the total problem solving process. Individual production rules therefore frequently possess a kind of local plausibility which enables them to be discussed sensibly in isolation. With most other techniques, the parts cannot be isolated out of the system to be discussed and modified; the system has to be discussed and modified in toto.

This structural independence of the production rules has two important consequences. Various sets of production rules can be combined freely to form working production systems.

This makes it possible to show how certain production rules or schemas perform critical functions in more-than-one number-related task. Secondly, it is possible to incrementally add new production rules or modify previous rules to extend a production system so that it can handle more complex tasks or the same tasks in a variety of new contexts. This makes it possible to identify consistencies and differences between successful and unsuccessful performances on the complex number tasks very precisely. The use of production rules in the system being produced thus enables the authors to produce a powerful and flexible system which meets all of the criteria required of the system. As is illustrated in Figure 3 below, the prototype system consists of a network of three interrelated production subsystems: an executive subsystem (called MAINLIST), an equivalent fraction generating subsystem (called EQUIVFRACT), and a lowest common multiple generating subsystem (called LCM).

MAINLIST <——>EQUIVFRACT <——> LCM

Figure 3 The Prototype System

MAINLIST affects the overall operation of the system by selecting which of the other subsystems will be operational at any point in time. EQUIVFRACT generates equivalent fractions when asked to do so by MAINLIST; LCM is activated by EQUIVFRACT to generate the lowest common denominators.

For example, if the system is asked to calculate

1/2 + 1/3

MAINLIST first peruses the problem. When it finds that the two fractions have different denominators, MAINLIST activates EQUIVFRACT. Because EQUIVFRACT has not got any rules which enables it to generate the lowest common denominator, it in turn activates LCM. When LCM has determined that the lowest common denominator is 6, EQUIVFRACT is reactivated. EQUIVFRACT then converts 1/2 to 3/6 and 1/3 to 2/6. MAINLIST is then reactivated. The rules in MAINLIST then generate the answer 5/6.

The power of the system as a means to produce expert teacher diagnosticians however only really becomes apparent if one of the three following modifications are made to the system:

1 one or two critical production rules are removed from one or more of the subsystems;

2 one or more "buggy rules" (Van Lehn and Brown, 1980) are included in one or more of the subsystems; or

3 a combination of the first two types of modifications occur.

PR2B If you are required to add two fractions, then add the numerators and add the denominators.

Figure 4 "Buggy Rule PR2B

For example, if Buggy Rule PR2B is added to MAINLIST, the following scenario could occur if the system is asked to add 1/2 and 1/3.

The system peruses the problem, notes the addition sign and immediately operationalizes the addition operation rules. Rule PR2B then is executed. The system thus adds the two numerators (1 and 1) and the two denominators (2 and 3) to produce an incorrect answer of 2/5.

$$1/2 + 1/3 = 2/5$$

This, by the way, is one of the most common errors that children make when adding fractions with unlike denominators. By experimenting with modifications to the four production systems, the experimenters have been able to reproduce most of the common errors that children make when adding and subtracting fractions.

How the System will be used

As was stated earlier, by making modifications to the lists of production rules within the sub-systems, it is possible to reproduce most of the error patterns that occur when children attempt to add or subtract fractions with unlike denominators.

This characteristic of the system enables the production of a very dynamic type of interactive, computer-based tutorial. To maximize the effectiveness of the system, it is recommended that each tutorial should be attempted by a group of two to four student teachers. At the beginning of each tutorial, the student teachers will be presented with a worksheet of fraction problems done by an imaginary child. The student teachers first will be asked to identify the error pattern being used by the child. This is done by asking them to show on the computer screen how the child would do a problem similar to those on the worksheet. Following their correct identification of the type of error pattern, the student teachers will be asked to identify why the child is making the error and to suggest what the child needs to be offered in order to overcome the error pattern. In order to test their hypothesis about why the child is making the errors, the students will be asked to teach the relevant knowledge to the system. The students teach the system by adding and/or removing production rules from the system. This process is done by the means of a special menu. Once the student teachers have made their changes to the system, the system reworks the original worksheet of problems. If the student teachers diagnosis and remediation plan is sound, then the system will get all the problems on the worksheet correct. If their diagnosis and proposed remediation program is unsound, then two possible scenarios can occur; the system either makes the same errors as before or a new set of error patterns appears. In either case, the student teachers will be required to revise their diagnosis and remediation program and rerun the simulation. To help the student teachers gain deeper insights into what is occurring, they will be encouraged to hack into the production system and explore how the information within the system is structured.

Because this system's ability to reproduce most of the common error patterns children use when adding and subtracting fractions with unlike denominators, it will be possible to produce a graded sequence of tutorials so that student teachers may become more adept at diagnosing and remediating most of the common errors that occur within this domain of mathematics. The first tutorials thus will simulate the simpler types of error patterns while the later tutorials will simulate the compound and more complex types of error patterns. This will be an improvement on the one–off types of error pattern activities which student teachers presently do in their mathematics education courses.

Future Directions

The present version of the system is written in muLisp and is still being modified and improved to make it quicker and more user-friendly. Once it is fully operational, a Parser will be added to the system so that the users will be able to use almost Natural language to interact with and modify the system. The student teachers thus may be able to teach the system and explore how changes to the amount and the structure of knowledge stored in a child . Long Term Memory affects mathematical performance. This has a number of important possible consequences. First, it may facilitate the development of teachers as not just transmitters of knowledge but also as researchers. Second, it may help overcome many teachers' resistance to technology by helping them to realize that there are more educational uses for computers than just wordprocessing.

Once the natural language version of this system has been produced and field tested, the shell produced for this system will be modified for use with other domains of knowledge such as:

1 addition and subtraction of whole numbers;

2 multiplication and division of whole numbers;

3 addition and subtraction of decimal fractions;

4 multiplication and division of decimal fractions;

5 operations with percentages; and

6 operations with ratios.

A set of computer-simulation tutorials for most of the content domain areas in the K-10 mathematics curriculum thus will be generated from the prototype system which has been described in this paper.

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Using CD–ROM and multi–media for education and training

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Compact Disc Read Only Memory (CD–ROM) refers to a technology in which a range of data types, such as text, graphics, audio, photographs, and video can all be stored in digital form and accessed by conventional Personal Computers.

CD–ROM is best considered as a publishing platform, capable of carrying very large amounts of information (about 550 Megabytes) in a single, small format disc. As the term implies, publication necessarily means the mass production of discs at a factory, followed by widespread distribution of the product in the market place, including schools, colleges and universities. Of great significance is the fact that CD–ROM discs are not expensive to produce, and the hardware needed to use the discs (less than $1,000) is considered to be a normal peripheral device for a personal computer.

This point is best illustrated by comparing CD–ROM with its predecessor or companion technology, the Compact Disc (CD). Publication and distribution of music has recently been transformed by CD technology, and consumers are very familiar with the capabilities, audio quality, and low costs of both CD discs and the associated hardware for playing the discs. Technically the two disc formats (CD and CD–ROM) are very similar, the major philosophical difference being that access to CD–ROM discs is under the control of a micro-computer, whereas the audio or CD discs are normally controlled by a compact disc player with attached speaker and audio amplifier system.

Note that a CD–ROM player operating under computer control can access the audio segments on a CD–ROM disc as well as play a pure audio or CD disc and deliver the audio to an external loudspeaker or headphone set. However a CD player can only access the high–fidelity audio materials on a CD or a CD–ROM disc.

This paper, which discusses the educational applications of CD and CD–ROM, is restricted to *interactive* methods of delivering information and responding to student requests. This means that we are considering only the situation where a computer is controlling the delivery of materials through a CD–ROM player, but the source of materials may be any one of the following:

1 multi-media from a CD–ROM disc

2 audio only from a CD disc

3 audio from a CD disc but supplemented by text graphics, photos and video from the computer's hard disc

4 multi–media from a CD–ROM disc but supplemented by other materials from the computer hard disc.

Technology Outline

For the purposes of this discussion, it will be assumed that educational institutions are the primary group or client which needs to offer staff and students access to a range of CD-ROM programs. Budget pressures usually require that the delivery system, especially the computer hardware, is a simple or standard configuration which does not contain expensive additional peripherals. For example, the delivery system assumed for the products and techniques under discussion is a standard IBM-AT (286) personal computer or compatible, with hard disk, VGA display adapter and matching VGA monitor. There will be no reference to extra enhancements such as DVI technology or to DVA-4000 peripherals, both of which are more expensive than the entire computer configuration described above.

The CD-ROM player is a peripheral device which can be installed either internally to the computer, thereby occupying the same space as a conventional floppy disc drive, or an external player can be connected to the computer by cable. In some instances the player can be controlled by a PC acting as a fileserver on a network of PCs, or each PC can be fitted with its own player.

Data files, such as text, graphics and photographs, are read from the CD-ROM and transferred to the PC, but audio data can be accessed in a variety of ways, including the following:

a Control by the PC of digital audio on the CD-ROM, with final audio output being accessed directly from the audio socket on the CD-ROM player, or

b Transfer of digital audio files on the CD-ROM to a PC where the analogue audio is regenerated for output into a loudspeaker system or headset. Some versions of this technique use an inexpensive voice card to regenerate the audio, while other methods deliver the audio through a parallel port on the PC.

These methods of audio control have certain advantages and disadvantages, some of which will be demonstrated with the presentation of this paper.

Current Applications of CD-ROM in Education

Most of the current CD-ROM products on the market are database applications in which very large volumes of text and numerical data is available for searching. Examples in this category include dictionaries, encyclopedias, chemical information, statistical records and census data. Results of a search are often enhanced by the display of graphs and photographs.

Products can also be described in terms of their disciplines, such as Business and Computing, Earth Sciences, Educational, Entertainment, Health and Safety, Health Sciences, Library Sciences, Medical and Biomedical. There are several CD-ROM Directories available, including the 1990 edition of TFPL's Directory of CD-ROMs covering more than 816 products, and MICROINFO's CD-ROM Title Index of educational discs.

The Technology Based Training Group at Footscray Institute of Technology has been actively developing CD and CD-ROM programs for education, and existing products include the following:

a Essay Writing

b Learning Japanese (Basic Sounds)

c Spelling for Technologists

d A Talking Dictionary of Medical Terminology (Anatomy)

e The Foetal Heart

f Phonetics

g The VGA Sampler, which includes the following:

—hundreds of VGA quality colour photographs supplied by:

CSIRO Division of Information Services

RMIT Library (Fine ART collection and Anatomy)

—two text data bases using data from:

The Tourism Index, and

The Westdoc Database, both of which are searched by a commercial retrieval program, called SearchMagic, stored on the CD-ROM.

Most of the Footscray Institute of Technology (FIT) programs make extensive use of the audio facilities of CD-ROM in a technique called Interactive Audio. In this mode students are presented with the simultaneous delivery of visuals and audio. The controlling program ensures that the visual displays of text, graphics and photographs are also synchronised with the audio information. Such techniques enable the audio medium to carry most of the information in a clear natural voice, while the text is used to hold attention, and to reinforce the issues by displaying key words and phrases.

In some FIT programs there is a facility to enable students to talk back to the machine. For example in the Learning Japanese program, students can see and hear a set of sounds or words in Japanese delivered from the CD-ROM, then the students use a microphone to mimic the professional voice of the language teacher. Students can then compare their own efforts with the CD-ROM recording and repeat the process as often as required (or at least until the student feels that a satisfactory standard has been achieved). Individual student attempts at reproducing the sounds, words or sentences are saved on the hard disk of the computer for later analysis by a teacher.

Recent developments (*The Talking Book*)

One of our more recent developments is the *Talking Book* program, which interfaces a normal hard-copy book with both a computer and a CD-ROM player. This process enables the student to read the book in a normal way, to select a particular sentence on any page, then to hear that sentence read aloud in any language of the student's choice.

The text in the hard-copy book can be written in any language, or even multiple language fonts. Each sentence is associated with a unique icon which the student touches with a special pen. A data base is used to link the coded information with a specific audio sequence, which in turn is accessed from either the CD-ROM or from the hard disk.

Students can touch other icons to change language, then touch a sentence in the book to hear the sentence read aloud in this selected language.

An additional interactive mode allows students to touch the SAY-IT-

YOURSELF icon, then to use a microphone to record their own attempt at speaking a chosen word or sentence. This means that students can select a particular sentence, hear the correct pronunciation from the CD–ROM, then hear their own attempt for purposes of comparison.

The first set of booklets based on this technology are currently being published at FIT, with focus on the learning of foreign languages. Languages selected for trials with the new technique are those which are currently taught or planned for introduction to FIT courses (such as Japanese, Vietnamese and Italian).

We believe that the technology can also be used for helping students to learn English, including very young children just learning to read. Applications in this field are under development, and new curriculum materials for the *Talking Book* are being prepared. Although language learning is an obvious application for the new technique, we believe that curriculum materials in many different disciplines could be successfully developed.

One of the outstanding attributes of the *Talking Book* technique is its fundamental dependence upon normal hard-copy pages. Students can purchase their own copy of the book, giving them freedom to read the material at any time and place. When used in conjunction with an appropriately configured computer, students can receive the added dimension of audio.

From a producers perspective, the major advantages of this technique are as follows:

a Production costs and times are significantly reduced, and talking books can be prepared almost as quickly as curriculum designers can write the materials.

b Computer programs which control student access to materials (such as menu-driven controls) are significantly reduced in size and complexity. At the same time students gain far more freedom in their choices and options because the book itself is the menu and students can rapidly turn pages and commence reading/listening at any point in the book without going through any hierarchy or structured access.

Issues Involved in a CD–ROM Project

When developing an educational program using CD–ROM there are many issues to consider, including task analysis, instructional design, materials production (text, audio, graphics, photographs and video), computer program development, CD–ROM production, quality assurance, and marketing.

Design and presentation of these educational materials should be driven by a consideration of the target audience, and special thought must be given to accommodating a variety of learning styles. The multi-media capabilities of CD–ROM empowers producers to address these issues, and to explore a mix of techniques which is functional, informative, attractive and acceptable to students. Of greatest concern is that the programs do not simply entertain.

Our experiences suggest that most effort is expended in the early phases of preparation, especially analysis of the task, instructional design, script writing, audio and video production. Producing the controlling computer programs also requires significant development and effort. Emphasis on team effort is important since this stage requires close co-operation between subject matter experts, who are responsible for the content, and the production group who interpret the material and create the program.

Often the most expedient approach is to prototype the program on a hard disk platform, then to trial the interim product with students, prior to a final commitment to CD-ROM. Opinions and feedback from staff and students can be incorporated into the product during this development phase. Some CD-ROM manufacturers, such as Disctronics Australia, are prepared to produce single "check discs" for evaluation purposes prior to committing the master disc to the process of replicating large numbers. In either case, we strongly recommend that an independent editorial panel of content experts also reviews the program before commencing a mass production of CD-ROM discs at the factory.

Even after factory production of the disc, there is a testing and evaluation period. Errors, additions and upgrades to the program can still be included, although the CD-ROM contents cannot be changed. New or alternative materials, such as improved photographs, text and graphics can be delivered by floppy disc in conjunction with the CD-ROM. To some degree audio files can also be included on the companion floppy disc as upgrades to the existing CD-ROM contents. A new computer program, which controls access to the multi-media, can select materials from the CD-ROM, floppy disc or the computer hard disk as required.

Conclusion

CD-ROM is a delivery system which has many attributes ideally suited to Educational applications. The technology combines very large storage capacity of multi-media materials with the interactive control of a personal computer.

This paper has outlined some relevant aspects of CD-ROM technology, particularly interactive audio, and has endeavored to illustrate the style, diverse range and possible applications of CD-ROM to education and training. A brief outline of some issues relevant to the design and production of educational materials for CD-ROM was also given.

Of particular importance to educational institutions is the cost of materials development and hardware support for delivery of CD-ROM programs. In the case of programs produced at FIT, the delivery of high resolution colour photographs, audio and motion video has been achieve without any expensive peripherals. Emphasis has always been on making use of existing computer facilities which are likely to be found in educational institutions, rather than depending upon another layer of expensive supporting technologies.

One of our more recent developments, the *Talking Book*, was also described and the importance of this technique should not be underestimated. Although these *Talking Books* can be used in conjunction with either a CD-ROM player or a hard disk, the special attributes of optical discs makes this delivery system particularly attractive.

The rapid acceptance and penetration of CD-ROM players into all levels of educational institutions suggests that this technology has a basis for future development. Educational software to accompany the hardware has appeared in the form of databases of information as well as interactive multimedia lessons and computer based training programs.

To harness the power of CD-ROM for educational applications and to ensure the future role of CD-ROM in teaching and learning we need the commitment and energies of talented curriculum developers to produce quality materials. We also need a greater degree of co-operation and understanding between curriculum developers and educational technologists.

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