COMMUNICATION RESEARCH TRENDS

A Quarterly Information Service from the
Centre for the Study of Communication and Culture

Vol 7 (1986), No. 2

Children, Computers and the 'New' Literacy

In Kubrick's sci-fi film *2001: A Space Odyssey* the spaceship's computer, named HAL, is made out to be a perfect machine though with human emotions and human fears. It can guide and plan with precision and also lip-read, sing, and conspire to take control. As its machine life systems are switched off, it cries out, 'I am afraid; I can feel it.'

HAL is a popular image of the hopes and fears that beset contemporary Western man in the face of the computer in government, business, science and education and the family. The hope is that the drudgery of work and study will be eased, leisure enriched, and knowledge and learning advanced. The fear is that man can lose control of the 'thinking machine' he himself has created. Massive unemployment in 'post-industrial' societies is only one of the symptoms of this loss of control.

Children of the more affluent families in these societies are taking to the microcomputer and word-processor in ever-increasing numbers at home and at school, as excitedly perhaps as to television, the cassette player and video in earlier times. What are the social, cultural and educational implications of this micro boom? How is it changing concepts and structures of teaching and learning, and indeed of education itself? How is the skewed diffusion of micros widening the gap between information-rich and information-poor families, within nations and among nations?

This issue of *TRENDS* highlights the major approaches to the introduction of computers into the schoolroom, reviews the literature, and suggests questions for further research.

REVIEW ARTICLE

I: Concepts of Literacy: Computer Literacy and Education

Benjamin M Compaine. *Information Technology and Cultural Change: Shaping a New Literacy?* Center for Information Policy Research, Harvard University, 1984; 'The New Literacy', *Daedalus*, Winter, 1983.

Compaine argues that teletext, videotex, the personal computer and interactive video are introducing a fundamentally different stage of 'literate' thought patterns, especially among children.

In his conception of the history of literacy, Compaine is following the views of Goody, Innis, McLuhan and Ong that there is a close interrelation among new communication technologies, thought processes connected with information processing and a cultural era. This theory organises cultural history in terms of the stages of orality, writing, print literacy and now electronic literacy.

In oral cultures, the storage, retrieval and interpretation of information is largely through narrative memory devices such as the skill of the bard in recounting long epic ballads simply by remembering the basic plot of the story. This encourages essentially narrative rhetorical thought patterns in the culture.

Literacy of the Alphabet and Print Medium

The invention of the alphabet led to a new stage of logical thinking that is not possible with oral expression. With writing, great quantities of information in abstract lists and long, meticulously detailed reasoning could be stored without dependence on memory devices. Writing emphasizes explicit, denotative expression while oral communication is figurative and connotative. Thought moves from narrative, rhetorical structures to logically sequential, linear patterns. Unlike oral communication, which occurs largely in a face-to-face, communitarian context with audiences immediately present and reacting, the writing and print medium tends to separate and create distance between sender and receiver. Thus, the technology of the quill pen, cheap and mass-produced paper, movable type and the mechanically powered rotary press have all influenced the traditional concept of literacy. Even drama, film and television have tended to be influenced by the technology of writing, the print medium and the conception of literacy in terms of linear thought patterns.

The New Electronic Literacy

Compaine proposes that video games, personal computers and computer networking are bringing a form of accessing, processing, transmitting and displaying information which is significantly different from print and that this may form a new type of literacy. He is not referring to computer literacy in the sense of being able to master computer programming languages and general computer use. Rather, literacy means a particular mode of creating and interpreting symbols which are the basis of human knowing. The impact is likely to be more noticeable in a new generation of children because they have not been thoroughly trained in the linear patterns of thought and because computerisation is aimed especially at children in the form of video games and school computers.

Compaine admits that computer storage and retrieval of data may be only an extension of print media and print literacy. Print was not so much a break with hand-copied forms of writing as a technology which reinforced the long-established uses of written rather than memorised records. So also video games, personal computers, electronic mail, automatic teller machines, and data base publishing are not isolated or mutually exclusive developments. They are pieces of a dynamic process, a coming together of various forces with the potential for a new set of effects on patterns of thinking, on cultural world views and values, and on socio-political organisation.

Consequently, digital processing of information has introduced significant changes. Firstly, there is almost immediate retrieval and display from a large data base potentially as extensive as the global network of interconnected computers. It is not necessary to move away from one's desk to go to libraries or to transport printed materials through mail. The assembly, organisation and *interrelation* of disparate forms of information is far more rapid and flexible. Secondly, and more important, the user can manipulate the processing of information. Unlike books or broadcasting, where data is organized in set form by the sender, the computer enables one to input information directly into the data bank, selectively bring up whatever data is immediately significant *for the user*, reorganise and create images or data on the screen and selectively store information that is of particular interest. Thirdly, calculators and word-processing programmes which automate certain mental processes like counting and spelling are likely to make redundant many remnants of memory devices from an oral or print culture such as memorising multiplication tables, spelling and grammar, or elaborate indexing systems.

What is the New Form of Literacy?

Compaine terms print-related literacy 'Literacy I' and suggests that computer management of information may bring a new type of creation and interpretation of symbols which he calls 'Literacy II'. The ability to manipulate and creatively organise information may lessen dependence on sequential, linear logic and emphasise the capacity to make intuitive, imaginative leaps, rapidly exploring new organisations of information that occur to the user as possible. The virtually simultaneous presence of diverse forms and levels of the symbolic interpretation also makes possible a more holistic perception in which various aspects of a question are considered simultaneously as parts of a system and interrelated in a unified way. Instead of being caught in one sequential line of thought, the computer facilitates rapid horizontal linkages with very different concepts of reality, a process which is often the basis of scientific and cultural discovery.

The Role of Culture

Compaine is hesitant about predicting that these changes in thought patterns or culture are certain, inevitable or likely to occur in a particular way. He avoids the trap of technological determinism and recognises that cultural values are an independent factor. Cultures have responded differently to the development of print technology. Literacy is, after all, a cultural value, and forms of technology have developed because of a value placed on it. Social, economic and political institutions influence the way technology is used and who benefits from it.

Compaine recognises that his suggestion of a new type of literacy is, at this point, quite speculative. His intention is to propose a framework for analysing the complex relationship between information technology, forms of literacy, basic patterns of thought and more fundamental cultural and social change.

Compaine's discussion of computers in terms of a new literacy also highlights the fact that computers are not simply neutral labour-saving instruments as they are popularly thought to be. They have great significance for personality and cultural development. Nowhere is this question more evident than in the hot debates regarding the use of computers for educational purposes. The wholesale introduction of personal computers in schools has spawned a wide variety of conflicting theories of the educational psychology of computers and divergent methods of using computers in schools.

II: The Skinnerian Influence: Computers as Teaching Machines

Dale Peterson (ed.) *Intelligent Schoolhouse*. New York: Prentice-Hall/Reston Publishing House, 1984. Tim O'Shea and John Self. *Learning and Teaching with Computers*. Sussex: Harvester Press, 1983 Cf. Chap.IV. 'The History of Computers in Learning'.

The history of computers as educational tools goes back to the late fifties and the early sixties. In those days computers were much too massive to be installed in classrooms. What the children saw were terminals in the form of visual display units and keyboards. The computer itself, housed in a large building, was as remote as a television station. It was a mystical teaching machine for 'drill and practice' exercises, particularly useful for remedial courses for the slow learner and for the handicapped.

According to Peterson the idea of a teaching machine was first proposed in 1925 when Sydney Pressey, a psychologist at Ohio State University, demonstrated a metal-box type machine, with four buttons or keys on the side, and two small windows on top. It could be used for testing multiple-choice questions. A multiple-choice test would be displayed on a sheet of paper, and a coded list of answers would be inserted into the machine. The student took the test by observing the question number in one of the little windows in the machine, reading the corresponding question on the sheet of paper, then pressing one of the four keys corresponding to one of the four possible answers. The second small window showed the cumulative number of errors.

Skinner's Teaching Machine

B.F. Skinner, the behavioural psychologist, demonstrated a more sophisticated teaching machine a few years later. Skinner had concluded from his laboratory experiments on white rats that children could be taught on behaviourist lines. What was needed for a suitable response to a stimulus was an adequate reward.

The first computers for education were influenced by this behaviourist philosophy. O'Shea and Self argue that the methodology of linear programming is derived from the principles of operant conditioning, the basic law of which states 'if the occurrence of an operant is followed by the presentation of a reinforcing stimulus, the strength is increased'. According to this Skinnerian law, teaching is simply 'the arrangement of contingencies of reinforcement'. Thus the teaching material has to be organised so as to maximise the probability of correct responses, and teaching has to proceed by reinforcing successive approximation to the desired behaviour. With linear programming taking over, Skinner declared, the teacher was out of date, at least as far as reinforcement was concerned.

Linear Programming

The main contribution of linear programming, say Shea and Self, is its emphasis on the importance of feedback and learning at the individual's own pace, twin gods much worshipped in the computer-assisted learning literature. However, feedback is considered to be important only after correct responses. The only individualised teaching which students receive is that they may work through the material at the pace of learning which suits them best. There is no way that they may receive material different from that received by other students.

From the beginning Skinner contended that effective linear programming required mechanisation; only later was it emphasised that the principles of linear programming were independent of any particular teaching medium. By an unfortunate accident of history, computers were becoming widely used at just the time when the teaching machine was introduced. The technique of linear programming in computer-assisted instruction (CAI) has long become extinct, but to this day, assert O'Shea and Self, its ghost is still with us in the form of 'drill and practice' software.

Intrinsic Programming

In the late 1950s Crowder challenged the linear programming approach. He wrote that 'the essential problem is that of controlling a communication process by the use of feedback. The student's response serves primarily as a means of determining whether the communication process has been effective and at the same time allows appropriate corrective action to be taken'. Crowder called his approach 'intrinsic programming' because it was sensitive to the students' own intrinsic needs and responses. Alternative answers rather than totally correct or incorrect answers came to be accepted. The student also received some comment upon the responses and either repeated the frame or moved on to the next in a predetermined sequence of frames.

Programmed Learning

Shea and Self feel that linear programming and intrinsic programming still share many similarities. Both, for example, stress systematic presentations by the programmer, and assume that this takes precedence over a learner's activity. Also both are more concerned with the efficiency of instruction than with the quality of learning, seeing learning as the acquisition of knowledge rather than experience, and ignoring the emotional and spiritual dimensions. The result is that programmed learning, a combination of both approaches, has come to be the essence of computer-assisted learning (CAL) today.

In programmed learning a topic is divided into short, numbered sections called frames, and each such 'frame' is followed by questions. Instead of mechanically proceeding to the next section in sequence, the student is instructed which section to go to next on the basis of answers given.

III: The Papertian Vision: 'Microworlds' of Turtles and Sprites

Seymour Papert. *Mindstorms: Children, Computers and Powerful Ideas.* New York: Basic Books, Inc. 1980.

Seymour Papert of the Massachussets Institute of Technology has tried to remedy these shortcomings of linear intrinsic programmes with an approach which takes the child to be a natural learner and an explorer. His development of a new approach to education based on children's learning experiences with 'turtle talk', a computer language which controls the movements of a robot turtle, has influenced thinking on educational computing world-wide.

Papert's philosophy of education rejects the use of computers for 'drill' and 'practice' exercises of computer-assisted learning or for programmed learning where the computer is just another educational tool. In both these uses, Papert argues, the computer rather than the child is in control. He proposes that the child can learn to 'programme' the computer if he or she enters the creative learning environment provided by 'turtle talk' or LOGO.

In this new computer language specially devised for children, the movements of the robot turtle (or its graphic equivalent on a VDU screen) are completely in the hands of the child. By tapping F1 on a typewriter-like keyboard he moves it a turtle-step forward; F20 moves it 20 steps forward, B10 forces it backward, and R90, turns it to the right at a right angle. Thus the turtle can be moved in any direction and at any angle, and can be made to form all kinds of shapes and figures, including houses, squares, flowers and birds.

In Papert's view education must be a hobby. The best learning takes place when the learner is in charge, and is not bound by a curriculum. His advocacy of the use of computers to create a learning environment is based on the conviction that children are natural learners: they can pick up maths as effortlessly as a language provided they live in 'mathland'. He goes beyond Jean Piaget's cognitive framework of the child's mind and his conceptualisation of the development of learning in terms of 'concrete' and 'formal' learning. According to Piaget a child starts thinking in 'concrete' terms at the age of six, and in 'formal' or abstract terms at age twelve. The computer, Papert believes, 'concretises' the 'formal' and gives rise to a learning process that does away with the distinction of Piaget.

'Microworlds of Learning'

Papert argues that the computer has made possible 'microworlds' of learning for the child. Microworlds are 'little worlds', 'little slices of reality'.

They are strictly limited, explains Papert, completely defined by the turtle (or the 'sprites', a recent innovation to turtle language). Yet they are rich, for inside these 'microworlds' the child is an explorer, a discoverer. Papert offers instances of how children have hit upon the meaning of angles, shapes and zeroes by playing with LOGO.

However, there are limits to each of 'these slices of reality'. Papert believes that 'not only in the computer context but probably in all important learning, an essential and central mechanism is to confine yourself to a little piece of reality that is simple enough to understand. It is by looking at little slices of reality one at a time that you learn to understand the greater complexities of the whole world, the macroworld'.

The Child as Explorer

In his child-centred philosophy of education which rejects the traditional 'banking' system of rote learning, it is the child who 'programmes' the computer. In doing so the child both acquires a sense of mastery over a piece of the most powerful modern technology and establishes an intimate contact with some of the deepest ideas from science, maths and the art of intellectual model-building.

In his view, computers affect the way people think and learn; they enhance thinking and change patterns of access to knowledge. For computers are more than physical machines: they are 'carriers of powerful ideas and the seeds of cultural change'. They can help people form new relationships with knowledge that cuts across the traditional lines separating humanities from sciences and knowledge of the self from both of these.

The Child as Epistemologist

Papert tends to 'personalize' the computer, and to 'mechanise' the child mind. Indeed, the 'holding' or 'addictive' power of computers, or the fact of 'mechanical' thinking does not worry him very much. Mechanical thinking, he writes, is appropriate and useful in certain situations. By deliberately imitating mechanical thinking the learner becomes articulate in what mechanical thinking is and what it is not.

Children, he believes, should learn to 'talk' to a computer in its own language, and employ it as a 'tool to think with'. Further, he is convinced that computers can provide children with 'new possibilities for learning, thinking, and for growing emotionally as well as cognitively'. Children, he believes with Piaget, are active builders of their own intellectual structures, and when they teach the computer how to think (as he is sure they do when they play turtle) they embark on an exploration about how they themselves think. This experience, he adds, can be heady: thinking about thinking turns the child into an epistemologist, an experience not even shared by most adults.

Papert's vision assumes a computer-rich society, where computers form a significant part of every child's life, and where each child can afford to spend hours exploring the shapes and forms possible with turtles and sprites. While the graphic turtle (or its robot equivalent) assists in the exploration of geometric concepts, the dynamic turtle, (developed by DiSessa and White), enables exploration and experience of a world of Newtonian motion with a few taps at a computer keyboard. 'Sprites' represent an advanced feature of turtle talk, mainly useful in the learning of physics.

Turtle Talk Across the Curriculum

David Woodhouse and Anne McDougall. *Computers: Promise and Challenge in Education.* Melbourne: Blackwell Scientific Publications, 1986. Tom Stonier and Cathy Conlin. *The Three C's: Children, Computers and Communication*. Chichester: John Wiley & Sons, 1985.

These two how-to books on educational computing, the first by Australian teachers, the second by British teachers, are enthusiastic and optimistic accounts of Papert's philosophy. They are unhappy, however, with turtle talk being restricted to the teaching of maths and physics. Such a restriction, they believe, perpetuates the myth that computers are only for science students, not for students of the humanities and languages. They direct their practical books at fellow teachers of all subjects, for it is their conviction that LOGO can be exploited across the curriculum.

They recommend the computer as a general data and information processor. Word processing by children can, for instance, dramatically improve their writing and composition skills. Further, the microcomputer can be used as a tool for learning about the world through educational software, educational and adventure games, and simulation exercises.

Micros for the Handicapped

Both books carry chapters on the use of micros as educational tools for the mentally and physically handicapped. The slow and handicapped learner is especially helped by computers slightly adapted to fit the handicapped person's needs. For instance, blind children in Australia have been helped by computerised braille producers, and in Japan deaf children have been taught to speak by using a model of the mouth and throat to show how sounds are produced.

Learning at one's own pace at the computer, say the authors, gives a measure of pride to the learner, and mistakes committed are not a public embarrassment. The computer can be employed across the curriculum in the study of language, liberal studies, music and religious education.

Learning to Share and Co-operate

What is more, groups of students working together imbibe a spirit of co-operation, of learning from and teaching each other. In working together they are more likely to verbalize what they are doing, and this, observe Woodhouse and McDougall, is a great aid to learning. They quote the example of the simulation exercise for learning economics called 'Lemonade' which involves a number of companies competing in the sale of the cold drink. A team of students run each company with responsibilities as chairman, production manager, sales manager and advertising manager. The result of such simulations, argue Woodhouse and McDougall, is not only learning about the subject matter, but also about how to work co-operatively and competitively with others.

Other advantages include the new stimulating environment promoted by the presence of computers, the variety and flexibility in classroom learning, and the autonomy they provide to children in their attempts to teach themselves.

Papert in Practice: The Limitations of Logo

Richard Ennals. 'Artificial Intelligence and Educational Computing' in Richard Ennals, Rhys Gwyn and Levcho Zdravech (eds.) *Information Technology and Education: The Changing School.* Chichester: Ellis Horwood, 1986. Roy D Pea, D Midian Kurland and Jan Hawkins: 'LOGO and the Development of Skills' in Milton Chen and William Paisley (eds.) *Children and Microcomputers: Research in the Newest Medium*. California: Sage, 1985.

Papert's radical alternative to traditional educational practices has not stood up well to actual application in the classroom. In MIT's Brookline Project (1979), for instance, two of the sixteen twelve-year-olds introduced to LOGO did not learn to programme, and some of the others could aquire only limited competence. In a New York State study it was found that the developmental level of the child was a vital factor in the ability of nine-year-olds to build up procedures. Playing with turtles was indeed very enjoyable, but the building of procedures fundamental to Papertian claims was found to be rather difficult.

Over several years, Pea, Kurland and Hawkins carried out a series of studies on teaching children to programme through LOGO. This is a programming language specifically designed to be easily accessible to children, and experience with LOGO is associated with general problem-solving abilities and skills in programming. The three researchers sought to find out whether learning LOGO developed cognitive skills.

Their longtitudinal studies lead them to conclude that learning thinking skills and how to plan well is not intrinsically guaranteed by the LOGO programming environment; it must be supported by teachers who tacitly or explicitly know how to foster the development of such skills through a judicious use of examples, :andard projects, and direct instruction. Further, the LOGO ınstructional environment is devoid of curriculum and lacks an account of how the technology can be used as a tool to stimulate students' thinking about such powerful ideas as planning and problem solving. Curiously, teachers are told not to teach, but are not told what to substitute for teaching.

Evaluating Logo

Ennals informs us that in 1983 at the University of Edinburgh Helen Finlayson learned from her research that the level of thinking required and the need for a familiarity with left and right, means that only those above seven years of age could handle the procedures. Yet another limitation of LOGO is that a lot of memory space is necessary to take full advantage of turtle language. Children appear to tire easily with drawing and manipulating shapes.

In France the Centre Mondial de Programmation conducted an extensive evaluation of LOGO, but it foundered because of untrained researchers. In Senegal LOGO was translated into the Wolof Language and in La Reunion into Creole, but the reports are not heartening. Few programmes seem to progress beyond the LOGO commands TO HOUSE and TO SQUARE, which help a child create 'houses' and 'squares' of different sizes on the screen.

Papert's Challenge

Papert's educational philosophy has challenged both the traditional school curriculum and attitudes to children and learning. The mass media and now computers have broken down the traditional barriers between the disciplines. The participants in the educational process are the same, but the introduction of the media and the computer seem to raise other questions. As Ennals asks: Are we to follow Piaget and centre our focus on the child, or emphasise forms of knowledge? Should we be providing a tool for the teacher, or a means of freeing the individual for a personal educational experience? What significance should be accorded to the computer, especially once the novelty of its use has worn off?

IV: The Marxist Critique: Making People into Machines

Pam Linn. 'Microcomputers in Education: Dead and Living Labour' in Tony Solomonides and Les Levidow (eds.) *Compulsive Technology: Computers as Culture*. London: Free Association Books, 1985, pp.58-101.

Pam Linn protests that the sweeping political rhetoric which links introduction of computers to the economic survival of Britain or other countries is preventing a careful critique of the alienating, dehumanising effects of new technology. Computers can bring many advantages, but they must be introduced in a way that truly ıhances greater worker participation, creativity and freedom. She suggests that the Marxist analysis of the labour process can be a helpful tool for unmasking the hidden forms of extended managerial control over workers' minds that is embedded in the hardware and software of computers.

One typical example is what she calls the 'technicist inversion': a set of practices which attributes human consciousness to machines and mechanises human labour processes. Management treats technology and human labour as entirely interchangeable with the only criteria being *cost* and *profit* considerations. On the one hand, computers are accorded superhuman powers. The use of terminology such as 'knowledge-based systems, *information* technology, *intelligent* terminals and *expert* systems' betrays a deeper logic that confuses inert data manipulation with human knowledge. On the other hand, computers can introduce a style of standardisation and control of the processes of production that tend to make human labour simply an extension of the machine. The early training of children in the use of computers in schools is rarely accompanied by critical reflection on the routines in human work that computers bring. Busy teachers often see computers as simply useful, neutral instruments that relieve them of active teaching.

Linn suggests that educationalists, school authorities and students should reflect more critically on the purposes of computers in schools and the military, industrial and commercial purposes that are built into computer hardware and software long before they are introduced into schools. Teachers should also exert more control over the information systems of computers and seek greater freedom ı syllabuses.

Class Struggle in Schools

State schooling in Britain, avers Linn, has been a significant terrain for class struggle. Innovations in education have invariably been debated in 'class' terms; the present controversy about race and gender, too, is symptomatic of this class struggle. However, education in computer technologies has not stirred any controversy or debate. It has been assumed by all political parties and even by educationalists, that computing education is indispensable to a modern society. No other technology or commodity has received such wide support from government and industry. Indeed, argues Linn, computing has been presented as economically indispensable, as a panacea for economic recession, and as a means for qualifying for employment.

Linn examines how computer literacy came to be part of the school curriculum through pressures from departments of trade and industry and from political parties. She also examines the ways in which computers have taken on the glamour of sci-fi as 'all powerful, yet flexible and precise, seductive and user-friendly'. She detects a peculiar anthropomorphism in all these attempts to humanise the computer.

Turkle's Study of Children

Linn concludes her analysis with a critique of Sherry Turkle's ethnographic study of children's intimate relationship with micros, and her categorisation of that relationship into 'hard' and 'soft' (Cf. CRT, Vol.6 (1985) No 3 for a detailed review of *The Second Self: Computers and The Human Spirit.* London: Granada, 1984). Turkle's analysis, observes Linn, follows from an exaggerated view of computer uniqueness and a narrowly Piagetian definition of learning. Having set up a dualism--'hard' and 'soft'--argues Linn, she sets out to fit all her subjects (only ten in fact) into these sterotypes. Further she abstracts these children from the cultural context of school and presents them solely as psychological entities. Her research methodology, too, observes Linn, is questionable, as she starts with the assumption that children will identify with and be gripped by computers.

What is more, Linn points out that Turkle assumes that computers have an intrinsic power to be user-friendly. She does not, for instance, report on the frustration and boredom of some kids with turtle talk.

V: The Luddite Approach: Technology as a 'Vehicle of Power'

Frank Webster and Kevin Robins. *Information Technology: A Luddite Analysis*: Norwood, New Jersey: Ablex Publishing Corporation, 1986.
Frank Webster. *Dangers of Information Technology and Responsibilities of Education*. Oxford: Faculty of Modern Studies Occasional Papers No.2, Oxford Polytechnic, 1985.

The Luddites were, according to popular British history, organised bands of English handicraftsmen who rioted in 1811 for the destruction of the textile machinery that was displacing them. Webster and Robins argue that this popular view of Luddism is a parody of what was in reality an important social and cultural movement which rejected the exaltation of technology above human values and purposes. The Luddites, for instance, did not equate technology with 'progress' but rather with a vehicle of power, as a force inimical to their culture, their values and their way of life. The values promoted by the emerging technology represented the values and priorities of industrial capitalism. Webster and Robins subscribe to the Luddite view that technology is not a central social force bringing progress in its train, but rather an expression of social and political power relations.

A Luddite approach, therefore, is a way of seeing rather than an advocacy of futile and failed machine-breaking, a method of questioning who gains, who decides, and why particular machines are being developed in the first place. Webster and Robins thus see their Luddism as an intellectual endeavour which tries to understand and explain the enthusiasm for computer literacy programmes.

Myths of Computer Literacy

The *raison d'etre* of computer literacy programmes is that young people need to be prepared to live in a 'post-industrial' society. Such a society, it is stressed, is largely based on information, and the fastest processor of information today is the computer. Where the traditional 3R's served the industrial society well, so the argument goes, computer literacy will be needed to cope with an information-rich society. Further, it is claimed, the 'new' literacy will provide 'skills' to service the information-based employment market. The 'new' literacy will also give students the 'power' that goes wi[th] this ability to access information.

Most programmes in computer literacy aim at 'demystification' of the new computer technologies. Webster believes that such programmes in fact only succeed in reinforcing certain 'myths'. For instance, by insisting that computer literacy courses provide practical hands-on training, the impression given is that students will be able to do something with the new technologies. It gives them a false sense of power, and of having acquired 'high skills'. The myth that high technology equals high skills has been engendered by the fact that computer-related jobs are done by white-collar workers (hence called 'professionals') and the computer carries an image of being recondite and super-demanding. The history of technological change, notes Webster, is of a process which has resulted in minimal skill requirements of most workers and arguably has systematically deskilled them. An instance of this is the assembly line, depicted so graphically in Chaplin's 'Modern Times'.

What they are not taught is what information technology is really about: that computer systems are generally in the hands of corporate and state organisations, that the military and the police are prime users, that privacy is under constant threat, and that national sovereignty is at the mercy of transnational data flows.

Webster offers an incisive critique of the British schools movement in information technology that seeks to make everyone computer literate in a computer-rich society. His challenge is three-fold: In the first place, he believes it is totally irrelevant to the problems of poverty, unemployment and illiteracy in both the developed and developing countries. Then, it widens the g[ap] between the information-rich and the information-poor, and does not provide any special vocational or academic skills. Finally, its real importance lies in the hype drummed up by corporate capitalism.

VI: 'Demythologising' Computers: The 'Emancipatory' Approach

Michael McFarland. 'Bringing Computers into our Schools – Gracefully' in *Jesuit Secondary Education Association (JSEA) News Bulletin*. Washington. Vol XIII, No 5 February 1983.

McFarland urges that more than just responding to pressures schools must provide an education in understanding, interpreting and humanizing the computerization of our culture. A liberal education today, he says, means freeing our students from the intimidation and sense of inadequacy that so many people feel when they encounter computers, and teaching them to take responsibility for how our technology is used.

The first step ought to be a 'demythologisation' of the computer through hands-on experience. It is important, however, that students are made to feel responsibility for what the computer does, and to realize that they are always in charge. Computers can be addictive and isolating, and therefore working in groups should be encouraged. Computers have the potential to be used for domination, for controlling resources and manipulating people. Hence the need for a computer education that is both creative and humanising.

Five Objectives

McFarland outlines five objectives for any course in computer education. Firstly, competence in computer use through problem-solving is imperative so that students become 'comfortable' with computer technology. The kind of thinking, the creativity and logical discipline demanded are worth learning. This competence, McFarland believes, is valuable in itself, and forms the basis of the other four objectives.

Secondly, integration of computer studies into the whole curriculum must be seen primarily as part of the way we relate to our environment and to our society. It has relevance to many of the school subjects, and they have relevance to it. So, all departments and all staff need to be involved.

Thirdly, personal interaction through working in groups should be seen as a social activity. Students need, therefore, to share the boredom and the rewards and should be accountable to others f[or] what they do. They must develop the ability to explain, defend an[d] adapt their work according to the needs of others.

Fourthly, creativity can be stimulated through giving students a certain amount of freedom and opening up new possibilities. There is need for involving students in meaningful projects that exercise their creativity and help them see themselves as responsible to a larger community.

Finally, critical evaluation of the actual use of computers in society must necessarily be an important part of any computer education programme. Serious questions have to be asked, for instance, of the large-scale displacement of workers as a result of automation in industry, of 'technology transfer' with the purpose of domination, and of the military and state exploitation of computer power.

A computer education programme with these challenging goals will ensure that students will encounter the new technology with competence, not fear; with a sense of solidarity and social responsibility rather than in isolation; and intelligently and critically, with neither a romantic unthinking acceptance nor a sterile negativity.

Pedagogy of Computer Games: Creating Learning Environments

Ramon Zamora. The Pedagogy of Games; Thomas W. Malone. 'What Makes Computer Games Fun? Guidelines for Designing Educational Computer Programmes' in Dale Peterson (ed.) *Intelligent Schoolhouse: Readings on Computers and Learning*. Virginia: Prentice Hall, 1984.

Research studies in Britain and the United States point to the fact that the main computer activity at home is the playing of games. The educational use of home computers is rather limited both in terms of software and actual interest.

Zamora believes games help fulfil the innate need among children to learn to control aspects of their environment. It is a means of acquiring competence that is not always possible at school which children often experience as emotionally stifling and threatening. Games provide the child, he argues, with a world where competence can be gained away from the pressures of peers in a congenial manner and at a stimulating pace. Acquiring competence in one area invariably develops competence in other areas. Most importantly though, observes Zamora, such a competence leads to a positive attitude toward acquiring competence in other areas.

Computer games in his view contain embedded or implicit learning materials. Once these are uncovered the game may cease to be merely a game for the observer, but the player may not see the dichotomy, and does not need to, for nothing new has been created. In the 'pedagogy of games' approach, according to Zamora, you need only study the game, and understand what it is already teaching.

He then examines the implicit learning materials of popular computer games. He looks at video arcade games, too, though he admits the learning material embedded in them is less oriented to intelligent problem-solving than to skills of action. However, he believes the characteristics of arcade games can be exported to formal learning situations. Some of these characteristics are: fast pace, simple-complex co-ordinated actions, rapid decision making, immediate feedback, clear cut goals, visual display of goals and results, and levels of challenge.

Malone's Research on Games

Malone's doctoral research at the University of Stanford on what makes computer games fun for children leads him to similar conclusions. He has developed a set of guidelines, based on this research, for designing highly motivated educational computer programmes. His major thesis is that instructional environments become intrinsically motivating and interesting when they evoke challenge, establish fantasy, and stimulate curiosity.

For an activity to be challenging, he argues, there should be a goal, and the outcome must be certain. Good goals must be meaningful at a personal level, and engage one's self-esteem. The attraction to the fantasy element in computer games derives from the emotional needs we have, though different people have different fantasy needs. Malone found that boys and girls of the fifth grade liked different versions of the game Darts. Whereas boys liked the fantasy of arrows popping balloons, girls just could not stand them.

A learning environment must also raise and satisfy curiosity, says Malone. This implies that the environment should be neither too complicated nor too simple in relation to the learner's knowledge. The elements of novelty and surprise are important, but to interest the learner feedback should be quick and constructive. Curiosity can be sustained by providing a sequence of increasingly complex tasks, each one of which introduces a complication that may surprise the learner, but which should be within one's grasp.

VII: Computer Education: The Theological Dimension

Michael Parsons. 'Theology and the Information Society' in *Media Development*, XXX 4, 1983, pp.32-35. And 'Computers and Religious Education', *Computer Education*, 10, 1, 1985, pp.245-250.

There is a general lack of theological reflection on computer communications technologies. One reason could be that it is only now that the churches have woken up to the potential for positive good the technologies possess. Earlier, since the churches had little contact with them, they were seen as an evil force, and a threat – 'the dark satanic mills' of the information age.

Parsons calls for the discovery of a 'redemptive use for these new and exciting technologies rather than fall into the old authoritarian patterns that deny responsibility to the individual'. It is because of the central importance of communication to the Christian gospel, argues Parsons, that the churches should take serious notice of computer technology, for it is influencing our work and leisure activities, our standards of living, the very quality of our lives. Indeed, it is the churches' task to be involved in the development of the technologies and the directions they take.

In particular, concern needs to be expressed about the misuse of computers. Public pressures will have to be brought to bear on the industry and professionals who man it so that individual privacy and security are protected, and that human values and dignity are preserved.

Another concern is of personal responsibility for making decisions. Is man's responsibility and integrity being undermined by allowing a computer to carry responsibilities that cannot easily be checked by a human being? Can the creation of systems that cannot be checked be morally defensible? Further, are there decisions that computers should not be allowed to take?

Are Computers a Problem?

The biblical dictum that man should earn his bread by the sweat of his brow – as a consequence of original sin – does not necessarily imply that work should be tedious and laborious all the way. Human creativity is of equal importance, though most employment is nothing better than drudgery. Computers may help to ease the drudgery and the labour of some jobs, but by and large they have made jobs and human beings redundant. The massive unemployment in the Western world today must be linked to the replacement of human labour by machines.

Parsons, however, does not consider computers, satellites and data banks as the problem, but rather human justice and social structures. At the same time, technologies are not value-free, and they, too, as technology per se, are the problem too.

The language of computers is linear and logical, modelled on Western rationalist-logical structures. The binary structure of computer language, says Parsons, is basically reductionist and deterministic, and these factors influence all computer analyses. Expert systems, according to Parsons, remove the deterministic algorithmic approach by teaching the computer to solve problems in a way similar to humans'. It is important to note, as Weizenbaum has pointed out, that the procedures of human thought are distinct from machine procedures.

Parsons urges that religious bodies, nationally and internationally, monitor and anticipate the effects of information technology and then make the appropriate representations. They need to raise their voices against the ever-widening gaps brought about between the information-rich and the information-poor, between the developed and the developing nations, and between groups in countries.

Need For Computer Studies

Computer Studies in British schools is generally regarded as a science course, but it needs to be part of a broadly based humanities discipline, and removed from the hands of the mathematicians and natural scientists, observes Parsons. The main justification for computer studies in schools is 'interaction with computers will be part of the experience of a large number, whether at work, in domestic contexts, or at leisure'. Parsons adds that the skills required for this and the skills taught in Computer Studies are not the same.

The kind of skills most likely to be employed – beyond the basic confidence in using the key board – would be the mastery of word-processors, data bases, information retrieval systems and general confidence to use the keyboard. This can be taught with only minimal assistance, for some command languages now approximate to normal English instructions. More important than these skills is an understanding of what computers are rather than how they work, what they can and cannot do, and how they are used in society.

Parsons would like to see the following topics discussed in any computer studies course: social impact, especially on the disadvantaged; data flow across national boundaries; essential differences between human beings and computers; the limitations of computers; effects on employment and the workplace, and on leisure; fraud, privacy and responsibility; and protection of data.

PERSPECTIVE

Educational Relevance of Computers: Questions for Research

Never before have industry and commerce been so actively involved in the classroom (1). Schools have received handsome donations of micros and peripherals, and teachers have received training at industry's expense. Never before, too, have federal government departments of electronics and trade been so generous in the effort to promote the 'computer classroom'. This is true of both developed and developing countries. Pilot projects in more than eighteen African countries and several Asian countries have been launched with this support. As a result, school priorities have become warped, abetted by enthusiastic parents who do not want their children to be left out in the cold.

A Question of Priorities

But many questions raise themselves at a time when other priorities appear to be more urgent, especially in the developing countries. Besides the physical needs of schools, better buildings, better textbooks, blackboards, facilities for games and sports, a manageable child-teacher ratio, teacher training, and teacher salaries, there are basic needs of students that have to be catered for.

Essential life skills need to be given top priority. Computer programming takes up a lot of school finance and school time which ought to be better spent in developing more relevant skills – reading, writing and numeracy, for instance. Computers are, after all, very 'hungry' media: the more hardware you possess, the more you will need to spend continuously on educational software ('edsoft') available today, though it is of a rather poor quality. While Stonier and Conlin characterise it as 'rubbish', Snyder and Palmer dismiss most educational programmes as 'inadequate and lacking innovation' (2). And yet parents and educators have an excessively high opinion of the computers' educational potency.

National Surveys of Computer Use

An analysis of the two National Surveys, in 1983 and 1985, on the use of computers in American schools (equipped with over 100,000 micros) suggests 'there is little evidence that in the average school teachers or students have been using micros to accomplish important tasks (3). Relatively few students have been using micros for constructing written essays; few, too, have been using micros for making up tests or student exercises; only the exceptional maths department has reorganised how and what it teaches in the domain of maths as a result of having the instructional tool of the computer.

In the United Kingdom and France the state-supported microelectronics programmes have fared disappointingly. According to a recent survey in the U.K. by the Department of Education only one secondary head teacher in five thought that the introduction of computers had made a significant contribution to teaching. On an average British secondary schools had a computer for every sixty children; in primary schools there was one computer for every hundred children. However, heads of primary schools of sixty per cent of the schools reported that computers had made a significant contribution to their teaching (4).

Studies of the use of microcomputers in secondary education in India (5) and Mexico (6) point to the role of government departments and transnationals in the introduction of computer literacy in these countries, and the poor response of teachers to the new educational tool. And thereby hangs a tale for other developing countries.

Beneficial Aspects

On the positive side, computers have been of immense use to the handicapped and the slow learner, and in general motivating children to explore the learning of maths and science, and with the help of word-processors to improve their writing skills. The visual attractiveness of micros has for some children created a stimulating environment for learning. The access to databases through telephone and teletext link-ups for schools that can afford them has obviously made learning great fun. Interactive video (video interfaced with a micro) offers great potential for explorations in history, geography, and other social sciences. (7) In tertiary and higher education computers have come to the rescue of researchers who need to manipulate and analyse massive quantities of data, and to present them graphically.

However, as Joseph Weizenbaum warns, an excessive interest in computable problems may lead educators and their students to ignore wider issues. Real world problems, he cautions, are not subject to the kind of rationality which is presented by calculation (8). Besides, the step by step nature of programmed instruction cannot match a five-year-old's creative insights and cognitive leaps, and, as many historians of the computer industry testify, computers were developed for the military, for business and for surveillance of citizens by centralised bureaucracies, and not for school instruction.

It appears, therefore, that what is of greater significance to children than computer literacy is 'computer education' (in parallel with 'media education') with the focus on critical thinking about the new information technology. This is clearly the burden of the arguments of Webster, McFarland and Parsons; but there is no reason why 'computer education and media education' cannot be integrated into one subject of study, for they have similar goals and speak the same language.

Evaluative Research

Research on microcomputers, children and education is rather limited. Milton Chen (9) and Debra Lieberman (10) conclude from their reviews of the research done in the first decade since the invention of the microcomputer that in the main the 'effects' and 'uses and gratifications' traditions of conventional television research have been followed. An added dimension has been the research into 'access' and 'diffusion'. The nature of children's 'interactivity' with computers needs to be further explored. How does this interactivity differ from 'interactivity' with parents, teachers, and the mass media? What are the cognitive processes at work when such 'interactivity' takes place? However, such psychological studies in isolation have little meaning if they are not also looked at in the context of structures at home and in school, in the community and in society at large. Close studies of the computer industry, nationally and transnationally, and their relationship to political and educational powers should help uncover questions of power and control in the 'computer classroom'.

The Nature of 'Computer Language'

The computer industry has been instrumental in inventing its own languages (e.g. LOGO, BASIC, PROLOG, FORTRAN), in giving currency to new words and phrases and in lending new connotations to words expressing personal relationships. In fact, computer language is altering the very shape of everyday language. How has such a language and the strictly linear and logical algorithmic procedures needed for 'talking' to computers influenced our relationships with machines and with fellow human beings? Moreover, how has the promotion of computer literacy in schools increased the knowledge gap between boys and girls, and between the dominant and minority groups?

Educational Questions

Considering that computer technology is changing so fast, obsolescence in the industry so rapid (only five out of the 220 microcomputer brands introduced in Britain three years ago survive today (11)) and 'compatibility' of systems unlikely in the near future, what are the real benefits of introducing micros into the classroom? How important is computer literacy in the development of a child's personality and his social education in the world of tomorrow?

It appears that such probing questions have not yet been asked. As Patricio Calderon of Chile (12) points out: Computer literacy has been introduced first, and then questions about its need and relevance asked. Invariably, this is done under pressure from government departments, acting under pressure from the industry. Or, as Donna Sharon and Audrey Mehler (13) in their evaluation of the research on computer literacy in Canadian schools conclude: Research is used more often to assess programmes already underway that to enlighten the path ahead for the development of appropriate technological applications. Few large-scale or longtitudinal research projects are addressing fundamental questions such as how the results of technology-based instruction compare with results of human instruction, what gender differences there are in response to technology, or how we can match uses of technology with types of content and individual learning process, or even more broadly, how we learn.

Keval J. Kumar
Issue Editor

REFERENCES

1. Douglas Noble: 'The Underside of Computer Literacy' in *Raritan: A Quarterly Review*, Vol.3, No.4, Spring 1984, pp.37-64; Reprinted in *Mass Communication Review Yearbook*, 1985, Vol.5.

2. Tom Stonier and Cathy Conlin. *The Three C's: Children, Computers and Communication*. Chichester: John Wiley and Sons, 1986. Tom Snyder and Jane Palmer. *In Search of the Most Amazing Thing: Children, Education and Computers*: Reading,MA: Addison-Wesley, 1986. Cf Kari S Wittman's review of Snyder and Palmer's book in BYTE, February 1987.

3. Cf Henry Jay Becker's analysis of the first survey in Milton Chen and William Paisley (eds.) *Children and Microcomputers: Research on the Newest Medium*. California: Sage, 1985, and his analysis of the second survey in 'Using computers for instruction', *Byte*, Feb. 1987, pp. 149-162.

4. John Clare. 'School Computers Fail To Make The Grade' in *The Times*, London, January 22, 1987. See also Jack Schofield 'Top of the League and Bottom of the Class' in *The Guardian*, January 29 1987, p.15.

5. Keval J Kumar. 'Media and Computer Education in India', Paper read at 1986 IAMCR Conference.

6. Carmen Gomez Mont. 'Microcomputers and Education in Mexico', Paper read at 1986 IAMCR Conference.

7. A Melezinek. *Interactive Video*. Klagenfurt: University for Educational Science, 1986.

8. Quoted in Dale Peterson (ed.) *Intelligent Schoolhouse*. Reston/Prentice Hall, 1985.

9. Milton Chen: 'Computers in the Lives of our Children: Looking Back on a Generation of Television Research'' in R E Rice (ed.) *The New Media: Communication, Research and Technology*. California: Sage, 1984, pp.269-286.

10. Debra Lieberman: 'Research on Children and Microcomputers: A Review of Utilization and Effects Studies' in Chen and Paisley op.cit.

11. Jack Schofield in *The Guardian*, January 8 1987.

12. Patricio Calderon: 'Educacio y Computacion: Hacia una Integracion Racional' (Towards a Rational Integration of Education and Computing). Paper presented at an Argentinian Convention on Education and Computing, November 1985.

13. Donna Sharon and Audrey Mehler. *Microcomputers in Teaching and Learning: An Inventory of Canadian Research*. TV Ontario, 1985.

Current Research on Children and Computers

AUSTRALIA

The Crippled Children's Assoc of Australila (Drys Road, Regency Park, Australia 5010) is engaged in a number of research studies investigating the nature of children's interaction with computers, and in particular, the effects of feedback and reinforcement on learning.

Dr Geoff Cumming (Dept of Psychology, La Trobe University, Bundoora, Victoria).

Dr David Woodhouse (School of Mathematical and Information Sciences, La Trobe University, Melbourne) has with **Ann McDougall** (Dept of Computer Education, Monash University, Melbourne) written on the promise and challenge of using computers in schools; cf. Review Article.

Dr Pat Fahy (Senior Lecturer, Catholic College of Education, 521 Old Northern Road, Castle Hill 2154, P O Box 201, Sydney) has written a draft document on the history and spirituality of computing, in an attempt to explore the ethics of information processing.

AUSTRIA

Prof Adolf Melezinek (Univ for Educational Sciences, Klagenfurt) has put together for UNESCO a report on the use of interactive video in education in Canada, the United States and Europe.

Dr Ingrid Geretschlaeger (Dept of Communication, Univ of Salzburg, presented a paper on 'New Media and Education in Austria' at the 1986 International Television Studies Conference in London.

CANADA

Donna Sharon (TV Ontario) has evaluated microcomputer use in Ontario schools (cf. bibliography).

Judith Tobin (Office of Development Research, TV Ontario) is examining the use of microcomputers in the Teaching/Learning Process in the Canadian school context.

CHILE

Prof Patricio Calderon (Director, Ctr for Educational Technology, Casilla 34-V, Valparaiso) does research on computers in education. He presented a paper on 'Educacio y Computacion: Hacia una Integracion Racional' (Towards a Rational Integration of Education and Computing) in an Argentinian Convention, Nov 1985.

Miguel Reyes (Univ de Playa Ancha de Ciencias de la Education, Valparaiso).

FRANCE

Nicole Gandilhon (Mission de Technologies Nouvelles, 96 Blvd Vessieres, 75017 Paris).

J Maymarkt & C Plaissant (CMIRH, 22 Ave Matignon, 75008 Paris).

HUNGARY

Dr Pal Szucs (Nat Ctr for Educational Technology, H-8200 Veszprem) does research on the use of microcomputers in Hungarian schools and has recently published 'The Use of Computers in Hungarian Education'.

INDIA

DECU (Space Applications Centre, Ahmedabad) has recently completed an evaluation of CLASS, a computer literacy programme in over 300 higher secondary Indian schools.

Keval J Kumar (Ctr for Mass Comm Research, Univ of Leicester) has completed a survey of media and computer access and use among Bombay's pre-high school students. He presented a paper on 'Media and Computer Education in India: The Need for an Integrated Media and Computer Education' at the 1986 IAMCR Conference in New Delhi.

Radhika Mullick (Living Media Research Unit, 304 Competent House, F-14, Connaught Place, New Delhi) has compiled an annotated bibliography of the use of computers in Indian education. She presented a paper on 'Computers and Western Modes of Thought' at the 1986 IAMCR.

ISRAEL

Dr Zahara Scherz (Dept of Science Technology, Weizmann Inst of Science, POB 26, Rehevot 76100).

ITALY

Forcheri and M T Molfino (Instituto per la Mathematica Applicata, Cnr Via L B Alberti, 4 Genova).

KOREA

Kim Seung-soo (Ctr for Mass Comm Research, Univ of Leicester) is doing doctoral research on the political economy of communication in China. The focus of his research is on the local and foreign monopoly capital and domination of communication technologies (including computers) in the developing world. He has contributed to *Contemporary Capitalism and Mass Media, 1986*, and to *Communicatio Socialis Yearbook, 1986*, on 'Political Economy of the New Communication Technologies: An Economic Mirage or Malaise for China?'.

MALAYSIA

M H Adnan and R Shankaran (School of Journalism, Mara) gave a paper on 'Microcomputers and Media Education in Malaysia: Positive Developments in the Use of Communications Technology'' at the 1986 IAMCR Conference.

MEXICO

Dr Alberto Montoya (Camino a Sta Teresa 13, Edif4, Depto 204, Heroes de Padierna 10700, Mexico DF).

Dr Antonio Ayestarian (Direcion General del CFREALC, Patriotismo 7114 piso, 03910, Mexico DF).

Carmen Gomez Mont (Universidad Iberoamericana. Depto de Communicacion, Av. Cerro de las Torres 396, 04 200 Mexico DF) read a paper on 'Microcomputers and Education in Mexico: An Analysis in a Crisis Context' at the 1986 IAMCR Conference. She is carrying out research on new communication technologies in the context of Mexican education.

Dr Enrique Calderon (Fundacion Arturo Rosenbleuth, San Francisco 1514, Col del Valle, 03100 Mexico DF).

NETHERLANDS

Dr J J Beishuizen (Vrije Universiteit, Subfaculteit de Psdychologie, Postbus 71 61, 1007 MC Amsterdam).

NORWAY

Asle Gire Dahl (Norwegian Council of Researchers, N-3503 Tryistand) continues his attempts to integrate media education with computer literacy in Norwegian schools.

SOVIET UNION

Dr Alexander Vocshinin (Moscow Power Engineering Institute, Krasnokasarmennaja 14, 112250 Moscow).

UNITED KINGDOM

Graham Murdock, Paul Hartmann and Peggy Gray (Ctr for Mass Comm Res, Univ of Leicester) are investigating how families in the East Midlands use video, teletext and home computers. Initially, they have found that computer ownership is heavily concentrated in better off homes, and the major use of computers is for playing games. (cf. their article 'Home Truths' in the *Times Educational Supplement*, March 6 1986, and their monograph *'Everyday Innovations* (CMCR, Leicester) for a preliminary report on their findings.

Prof John Ogborn (Dept of Science Education, London University Institute of Education, Bedford Way, London).

Dr Masoud Yazdani (Dept of Computer Science, Prince of Wales Road, University of Exeter) is developing intelligent tutoring systems especially for second language teaching. Has published extensively on AI and teaching machines.

Michael van Duren (Cognitive Studies, Brighton, Univ of Sussex) is examining children's representations of computing devices.

Richard Ennals (Kingston College of Further Education, Kingston-Upon-Thames, Surrey) is a co-founder of research projects in Australia, New Zealand and France, has contributed papers to several collections and journals.

Dr Peter Chandra (Dept of Educational Studies CAL, University of Surrey) is examining computer-assisted learning in the context of development.

UNITED STATES

Prof Alfred Bork (Director, Educational Technology Center, Univ of California, Irvine) carries out research in the use of computers in teaching and learning, especially in the application of computers to the teaching of physics.

Dr Milton Chen (Graduate School of Education, Harvard University, Cambridge Mass.) has done a doctoral thesis on gender differences in computer use and attitudes among adolescents.

Dr Henry Jay Becker (Project Director, Center for Research on Elementary and Middle Schools, John Hopkins Univ, Baltimore, MD 21218) has written extensively on the classroom and social context of micros. Currently directing research on effectiveness of using computers in remedial maths, logic and writing among schoolchildren (Grades 4 through 8) using a 'control group design'.

Debra Lieberman (Institute for Comm Research, Stanford) is a doctoral student of microcomputer uses and effects.

Karin Sheingold, Roy Pea, D Midian Kurland & Jan Hawkins (Center for Children and Technology, Bank Street College, New York) conduct research on processes, skills in the use of micros and interactive video in the classroom. They also design and develop hard and software relevant to the curriculum.

Marcia C Linn (Lawrence Hall of Science, Univ. of California, Berkeley) in science classrooms and is studying how instructional practice influences acquisition of problem-solving skills in programming classes.

Michael McFarland S.J. (Boston College, Chestnut Hill, MA 02167) has done a doctoral thesis on computers and technology.

WEST GERMANY

Dr Hans George Rommel (Tulpenweg 5, 5308 Rheinbach) is putting together documentation on computer activities and education for the European Council.

ADDITIONAL BIBLIOGRAPHY: COMPUTERS AND CHILDREN

General

Dictionary of Computing (Oxford University Press, 1983) The 'jargon' of computer language explained for the novice.

Rheingold, Howard. *Tools for Thought: The People Behind the Next Computer Revolution.* New York: Simon Schuster, 1985. An historical account – warts and all – of the first computer buffs, the hackers and the programmers. From Ada Byron (the poet's daughter), the first programmer, to Brenda Laurel of Atari.

'omputers and Schooling-Positive Approaches

Cerych, Ladislav. *Computers in Early and Primary Education: Policy, Problems and Issues.* New Jersey: Prentice Hall, 1985.

Chandler, Daniel. *Young Learners and the Microcomputer.* Milton Keynes: Open University Press, 1984. A realistic account of how micros can be used to make the learning environment more lively, but pointing out the limitations of LOGO, word processors, a computer-centred education.

Duncan K and Harris D. *Computers in Education*: Proceedings of the IFIP T C 4th World Conference, Norfolk Va, July 29-August 2, 1985. The papers discuss computer literacy, the ethical issues, the curricular and non-curricular aspects of computing, and computers in research.

Ennals, Richard, Rhys Gwyn and Levcho Zdravech (eds.) *Information Technology and Education: The Changing School.* Chichester: Ellis Horwood, 1986. Papers on educational computing presented to an international seminar sponsored by the Ministry of Education in Bulgaria. Includes papers on artificial intelligence, the pedagogy of information, and national perspectives from Europe and North America.

Evans, Nick. *The Future of the Microcomputer in Schools.* London: Macmillan, 1986. Describes the British experience and defends the government's policy of supporting microelectronics programmes in primary and secondary schools.

Evans, Susan H and Peter Clarke (eds.) *The Computer Culture.* Indiana: White River Press, 1984. Public lectures at Annenberg School of Communications by Everett Rogers and Judith Larsen on Silicon Valley, Seymour Papert on Microworlds and others.

Gosling, W. *Microcircuits, Society and Education: The Kingdom of Sand.* London: CET, 1978. Prof. Gosling's lecture to the Society of Educational Technology in 1979. An exercise in crystal-ball-gazing for the way education and society will be challenged by the new technologies.

Greenfield, Patricia Marks. *Effects of Television, Computers and Video Games.* London: Fontana, 1984. Advocates use of various media to promote social growth and thinking skills in school. A comprehensive review of the research on TV, computers and video games.

Howe, J A M and P M Ross (eds.) *Microcomputers in Secondary Education: Issues and Techniques.* London: Kogan Page, 1981. The difficulties of incorporating micros into the classrooms at all levels in the U.K. Offers advice on software needs of education.

Jonassen, D H. 'Learning Strategies: A New Educational Technology' in *Programmed Learning and Educational Technology, Journal of the Association of Educational and Training Technology.* Feb. Vol.22, l, pp.26-34.

Malone, T and J Levin. *Microcomputers in Education: Cognitive and Social Design Principles.* Report of a Conference sponsored by Carnegie Corporation, San Diego, Mar 12-14 (mimeo).

Margolin, Joseph B and Marion R Misch (eds.) *Computers in the Classroom: An Interdisciplinary View of Trends and Alternatives.* Washington: Spartan Books, 1970. An early collection of enthusiastic pieces on computer assisted instruction. Most contributors assume that computers will become the pervasive technology.

Megarry, Jacquetta et al (eds.) *Computers and Education - World Yearbook 1982/83.* London: Kogan Page, New York: Nichols Publishing Co., 1983. 22 articles on various aspects of computer use in education, with national case studies of Canada, France, South Africa, New Zealand and the U.K.

MUSE 86: Proceedings of the MUSE Summer Course, July 1986. (*MUSE Report* No.9, MUSE, P.O. Box 43, Houghton-on-the-Hill, Leicester LE7 9GX). Reports on this history of educational computing from the sixties.

Payne, T R G and van der Veer (eds.) *The Psychology of Computer Use: A European Perspective.* London: Academic Press, 1983.

Ramsden, Elizabeth. *Microcomputers in the Classroom (1982).* Papers on educational uses and implications of micros in a classroom setting.

Seidel, Robert J. *Computer Literacy: Issues and Directives for 1985.* New York: Academic Press, 1982.

Shank R and Colby. *Computer Models of Thought and Language.* San Francisco: Freeman, 1973.

Sharon, Donna. *Computers in Ontario Schools.* TV Ontario: Working Papers of the Office of Development Research, 1985. An assessment of the development of computer use in Ontario schools through open-ended interviews with 13 school board computer co-ordinators. Reports 'limited success' owing to the absence of a learner-centred perspective and the assumption that technology is a better way of teaching.

Sharples, Miles. *Cognition, Computers and Creative Writing.* Chichester: Ellis Horwood, 1985. Investigates cognitive psychology and education, and their relationship to children's writing skills with LOGO.

Sinatra, Richard. *Visual Literacy Connections to Thinking, Reading and Writing.* Illinois: Charles C Thomas, 1986. Traces developments from nonverbal to computer literacy.

Sleeman, D. 'Computer Literacy and the Schools: What is needed? What is Possible?' Unpublished ms. School of Education, Stanford, 1984.

Smith, P R (ed.) *Advances in Computer-Assisted Learning*. Oxford: Pergamon Press, 1986. Selected Proceedings from the CAL85 symposium at the Univ. of Nottingham. Papers include those on computer-assisted communication in education of the visually impaired, designing micro programmes for disabled students, computing aspects of interactive video, the computer and the pre – school child, social responsibility in technological environments, computers and religious education.

Taylor R P (ed.) *The Computer in the Schools: Tutor, Tool, Tutee*. New York: Teachers' College Press, 1234 Amsterdam Avenue, 1980.

Terry, Colin (ed.) *Using Microcomputers in Schools*. London, Sydney: Croom Helm, 1984. An attempt to define computer literacy. Pieces on use of computers in the teaching of writing, and first and second language learning.

Yazdani, Masoud (ed.) *New Horizons in Educational Computing*. Chichester: Ellis Horwood Ltd, 1984.

Critical Approaches to Computing

Anderson J S A. 'Can Information Technology Change the Curriculum?' in Alloway B S and G M Mills (eds.) *Aspects of Educational Technology XXVIII: New Directions in Education and Training Technology*. London, Kogan Page, 1985.

Fiske, Edward. 'Computers in most schools have brought no revolution' in *New York Times*, late 1984, in three parts.

Menosky J. 'Computer Worship' in *Science*, May 1984, pp.40-46.E

Nelson, Larry R. 'The Big Myth, The Big Worry, and Computer Litter-acy' in *Computer Education*, No.51, Nov 1985, pp.16-7. The big myth is that all jobs in the future will require computer skills; the big worry that kids will be disadvantaged if they don't learn now about computers; computer litter-acy is how to attack the big worry.

Orozco Gomez, Guillermo. 'Computadoras y Educacion Escolar: Una Vinculacion Inevitable?' ('Computers and Formal Education: An Inevitable Link?') Unpublished paper presented March 20, 1986. (Author address: La Quemada 442-A5, Col. Vertiz/Narvarte, Mexico, 03600, DF, Mexico). Argues that the use of computers in schools emphasizes trivial competency in information uses to the neglect of the more substantive capacities of interpretation and judgement on what information is truly important.

Searle J. *Minds, Brains and Machines*. London: BBC Publications, 1985. Lectures that challenge precepts of cognitive psychology.

Torrance, S. (ed.) *The Mind and the Machine: Philosophical Aspects of Artificial Intelligence*. Chichester: Ellis Horwood, 1984.

Weizenbaum, Joseph. *Computer Power and Human Reason: From Judgement to Calculation*. San Francisco: Freeman, 1976.

Williams, Fredrick and Victoria Williams. *Technological Child* (forthcoming). Situates the American child in the 'artificial environment' of media and computers, and the resulting psychological distance between parents and children in a 'programmed' world.

Computers and Children

Mullan, A P. *Children and Computers in the Classroom*. Kent: Castle House Publications, 1984. An introduction to the educational implications of computer-related concepts. Sets out to allay teachers' fears of the computer classroom, and suggests teaching styles to promote the Papertian approach to computing in education.

Wellington, J J. *Children, Computers and the Curriculum: An Introduction to Information Technology and Education*. London: Harper and Row, 1985. Focuses on effects of information technology on the learning process, and the curriculum in both primary and secondary schools.

Computers in Special Education

Hogg, Bob. *Microcomputers and Special Educational Needs: A Guide to Good Practice*. Stratford-Upon-Avon: National Council for Special Education, 1984. A useful practical manual for the special education teacher.

Howe, J. *Teaching Handicapped Children to Read-A Computer-based Approach*. Amsterdam: North-Holland, 1981.

Vincent, A T. 'Computing and the Blind: Learning to Cope.' in *Educational Computing*, 1984.

Vincent, Breda and Tom. 'Information Technology and the Disabled Student.' in Vincent, B. and T. *Information Technology and Further Education*. London: Kogan Page, 1985.

Computers and Ethics

Johnson, Deborah G and John W Snapper (eds.) *Ethical Issues in the Use of Computers*. California: Wadsworth, 1985. A reader on various ethical questions such as privacy, security and power. Critiques the professional codes of ethics; the intrusion of computer technologies in the home, school and the workplace; and the questionable practices of software specialists.

Schoppers, Marcel J. 'A Perspective on Artificial Intelligence in Society' in *Communication*, 1986, Vol.9, pp.195-227. An analytical discussion of ethical issues in AI, and the exaggerated hopes and fears associated with it.

Computer Education: Evaluative Research

Chen, Milton and William Paisley. *Children and Microcomputers: Research on the Newest Medium*. California: Sage, 1985. Excellent anthology of recent research of American children's access to and interaction with microcomputers.

Chen, Milton. 'Computers in the Lives of our Children: Looking Back on a Generation of Television Research' in Rice R E, Ed. *The New Media: Communication, Research and Technology*. California: Sage, 1984. pp.269-286. Compares television and the microcomputer research on children's interaction with both media. The emphasis in microcomputer research is on the thinking rather than on the passive child.

Paisley, William and Milton Chen. 'The Second Electronic Revolution: The Computer and Children' in Bostrom R (ed.) *Communication Yearbook 8, 1984*, pp.106-136. Beverley Hills, CA: Sage, 1984.

Periodicals

BYTE, February 1987. Supplement on Educational Computing with articles by Henry Jay Becker and others, and reviews of recent books and educational software.

COMPUTER EDUCATION from Computer Education Group, The National Computing Centre, Quay House, Quay Street, Manchester M3 3HU. Published thrice a year.

COMPUTERS IN SCHOOLS, The MUSE magazine, P O Box 43, Hull, HU1 2HD U.K.

COMPUTING TEACHER 135 Education, University of Oregon, Oregon.

DIALOGOS EDUCACIONALES, No 5, 1984, Ano 4.(Academia Superior de Cencias Pedagogicas de Valparaiso, Chile) Special issue on computers in education. 12 articles with the focus on theoretical studies and research results.

EDUCATION AND COMPUTING, a quarterly with several articles on experiences with computers in education.

INTERNATIONAL JOURNAL OF MAN-MACHINE STUDIES. Academ[ic] Press Inc., 24-28 Oval Road, London.

MICROCOMPUTERS IN EDUCATION Queue Inc. 5 Chapel Hill Drive, Fairfield CT 06432.

TIMES EDUCATIONAL SUPPLEMENT. (London) Issues of March 7 and October 24, 1986, contain several articles and reviews on the hardware and software of educational computing in the U K.

COMMUNICATION RESEARCH TRENDS — Published four times a year by the Centre for the Study of Communication and Culture ISSN 0144-4646

Editor: Robert A. White

Asst. Editors: James McDonnell, Paul C. Kenney

Subscription:

Individual:	1 year, US$7.50 (UK£4)	3 years, US$20 (UK£10)
Institutional:	1 year, US$12 (UK£7)	3 years, US$30 (UK£17)
Student:	1 year, US$6 (UK£3)	3 years, US$15 (UK£6)

Payment in US$ or equivalent in UK£, Canadian $ or W German DM.

Address all correspondence to:
COMMUNICATION RESEARCH TRENDS
221 Goldhurst Terrace
London NW6 3EP England Tel: (01) 328-2868

Typesetting and origination by Type Out, London SW16; (01) 677 1788
Printing by Roebuck Press, Mitcham, Surrey; (01) 640-9211

The CENTRE FOR THE STUDY OF COMMUNICATION AND CULTURE is an international service for communication research established by the Jesuits in 1977.

Executive Director, Leo A Murray; **Research Director,** Robert A. White; **Director of Documentation,** James McDonnell; **Director of Publications,** Paul C. Kenney.

International Board of Directors: Leeds: James Keegan; London: Joseph Munitiz; Carlos Valle; Madrid: Antonio Blanch; Manila: Ibarra Gonzalez; Paris: Michel Dubost; Rome: Peter Henrici, John E O'Brien, John J O'Callaghan.