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ABSTRACT

The significance of innovations in educational technology is examined. Issues such as measuring effectiveness and analyzing costs and the impact of these issues on classrooms, schools, and whole systems of education are discussed. A listing of current projects, with summaries, is provided. (Author/CO)

TOWARDS MORE EFFECTIVE TEACHING AND LEARNING:

NEW DIRECTIONS FOR EDUCATIONAL TECHNOLOGIES IN THE 1980s: RESEARCH AND STUDIES

Conducted for:
Education Forum Branch
Grace Watson, Chief
Susan Lueck
Horace Mann Learning Center
U.S. Department of Education

By The Learning Project
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September 15, 1980

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Towards More Effective Teaching and Learning
New Directions for Educational Technologies in the 1980s:
Research and Studies

I. Overview
Issues in Educational Technologies in the 1980s

New technologies have kindled renewed interest in their applications to education with unprecedented intensity. The spectacular rise of microprocessors and videodiscs has stimulated the development of inexpensive home computers, of new linkages between television and computers, of possibilities for real-time links via telecommunications facilities including satellites, of new human interfaces, and of new societal and institutional arrangements.

On the one hand, these and other present or projected developments could add up to significant new directions for educational technologies in the 1980s with far-reaching impacts on American education. On the other hand, a similar if smaller outburst of enthusiasm accompanied the introduction of interactive time-sharing systems ten years earlier, and tangible results failed to fulfill overenthusiastic promises. Separating out the new from old, the significant from the trivial, and the substantiated from the untested is no longer an easy task. This time, there are literally hundreds of projects, studies, and research efforts to assess.

The 1980s have also brought the beginnings of a new international dimension to educational technologies. Whereas in earlier years the leading work in instructional television, interactive computing, and integrated systems was American based, now other countries, most notably -- besides Japan -- France and its "10,000 Computers in the Classroom" program, have accumulated experiences or developed strategies which should be of great interest to American educators. These advances abroad have led some to say that American leadership in this area is being challenged and can no longer be taken for granted; more pragmatically, it has prompted others to seek out what in these experiences can contribute to improvements in the American context.

Two issues that deserve special attention at this point are teacher training and quality courseware development. Many technologists and their supporters have not given sufficient weight to those people and their creative thinking which will "make or break" the prospective revolution in education. If real progress is to be made in this field, then more will have to be done for and with teachers and software than was the case in the '60s and '70s.

Two other issues of special interest to educational policy makers -- measuring effectiveness and analyzing costs -- are likely to remain persistent problems. Nonetheless, substantial experience in these areas has been accumulated over the past decade; some of it is cited later in this report.

These and other issues -- and some of their projected or imagined impacts on classrooms, schools, and whole systems of education -- are reviewed in this report. At the same time, we were periodically reminded of the need to adopt as broad a perspective as possible in order to assess accurately the new directions evident in educational technology. It should be apparent that, in contrast to the late sixties when enthusiasm for educational technology also ran high, the environment in which education occurs has changed. We have entered an era marked by resource scarcities, unbalanced global interdependencies, a much-heralded but unevenly-distributed Information Age, and an uncertain future whose opportunities are easily matched -- if not exceeded -- by risk and threat. What is the significance of educational innovations in this future and what role can be played by educational technology? Can microcomputers and videodiscs "make a difference" in preparing people, especially children and adolescents, to cope with an increasingly complex and uncertain future? The question is not answerable with any reasonable degree of certainty. Nonetheless, we believe that, properly developed, educational technologies have a positive and not insubstantial role to play in improving future global prospects. For these reasons, the new directions emerging in the 1980s for uses of these technologies should be assessed, or reassessed, by those who contribute to the formulation of educational policy at all levels.

II. Who's Doing What? Some Selected Projects

In this report we have identified some recent studies or research efforts in educational technology, with an emphasis on computers and especially microcomputers but including television and other technologies where appropriate. Some projects reviewed here are well-known and now well-established (like Suppes' work or the PLATO system) which nonetheless continue to generate considerable interest. Others are much more recent, and address issues new to the '80s. A few "fantastic" projects (like Negroponte's "media room" at MIT) are included where they are representative of real-life issues. By necessity we have had to be selective; however, wherever possible, the reader is referred to other literature that covers work which because of time constraints could not be included here.

Also, some projects which deserve to be reviewed in more detail -- especially some of those abroad -- could only be briefly mentioned because information could not be obtained in time. In particular, the case of Japan should be investigated further.

What is striking to anyone familiar with educational technology ten years ago is how prolific the scene has become today. Researchers everywhere in America are building new systems for many purposes and are chipping away at old obstacles of every kind. Because of sheer numbers, we include below a list of names, with a short descriptor, that may help orient the reader, just as it helped us. The list served as working notes in the preparation of this report. It is in no special order; nor were all those it briefly describes included in the fuller description of Section IV. Nonetheless it may serve as a useful guide.

III. SUMMARY LIST: PEOPLE AND PROJECTS

Jacques Hebenstreit
Ecole Superieure d'Electricite
10,000 Microcomputers in French Secondary Schools

Seymour Papert
LOGO Project, MIT
Kids teach procedures to turtle robot. Learning math without teaching, in mathland. Cognitive growth may be different in a computer culture.

David Thomas
University of Iowa
Surveyed evaluations of CAI - it's quicker.

PLATO
Donald Bitzer, its father, University of Illinois, Champain/Urbana
Robert Caldwell, Southern Methodist University, says his PLATO reading program helps adult nonreaders.
Spencer Swinton of Educational Testing Service (ETS) found elementary PLATO math effective, reading not, and PLATO too expensive.
Richard Murphy of ETS found PLATO project for community colleges made no difference in achievement.
Howard Mark of Control Data Corporation is hooking color PLATO to videodisc.

Tom Dwyer
Project SOLO, University of Pennsylvania. Helping students learn to use computers "SOLO" under their own control.

The Xerox Palo Alto Research Center
Allen Kay
John Seely-Brown
Iva Goldstein
Using the computer as an intelligent coach.

Patrick Suppes
Stanford University. CAI in logic, set theory and languages;
Research on speech synthesis.
Computer Curriculum Corporation:
Large scale use of basic skills drill-and-practice.
The future: talking dialogues between students and computer tutors.

Dorothy Jo Stevens
University of Nebraska
Teachers have mixed feelings about computers, but think computers should be taught.

Sylvia Charp
Instructional Systems, Philadelphia public schools.
Long experience with computers in schools. Kids and parents learn together by computer.

Karen Billings
Columbia University. Helping educators use microcomputers.

Christine Doerr
Microcomputer and the Three R's -- "how to" for teachers

Ted Nelson
Computer Lib Dream Machine

Robert Albrecht
Menlo Park, California - "Computer Town, USA.

Arthur Luehrmann
Lawrence Hall of Science, Berkeley.
Bussing bushels of Apples (microcomputers) to schools.
The U.S. future depends on computer literates, doers with computers.

John Haugo
Director, Minnesota Educational Computing Consortium (MECC)
The largest educational computing network in the world.
Almost every school and college in the state uses computers.
MECC coordinates and supports.

Ludwig Braun
Stony Brook, New York
Huntington Project - developed 24 simulations, used them in schools.
Microcomputer advocate.
Proposing national centers of R & D for micros in schools.

Howard Peelle
Instructional Applications of Computers, University of Massachusette
Glass box approach - lets the student view the program he is using, removing mystery, providing models.

Alfred Bork
University of California, Irvine
Physics by computer tutorial
The future: stand-alone systems, graphics, videodiscs.

CONDUIT
University of Iowa
Jim Johnson, Harold Peters
Clearinghouse for courseware for college CAI.
Helps authors of courseware.
Researching educational effectiveness of graphics and audio.

David Moursand
University of Oregon
Editor, The Computing Teacher

Judy Edwards
Computer Technology Program, Northwest Regional Educational Laboratory
MicroSIFT: Clearinghouse of microcomputer materials for K-12 teachers.

Karl Zinn
Center for Research on Learning and Teaching, University of Michigan
The multiple uses of micros in schools and colleges.

Robert Lawler
LOGO Group, Artificial Intelligence Lab, Massachusetts Institute of Technology. A six-year-old learns to write, and more, in a computer-rich setting.

Stewart Denenberg
State University of New York, Plattsburgh
A PLATO course for computer literacy.

William Bozeman
University of Iowa
Reviewing studies of Computer Managed Instruction, concludes CMI is effective.

Nicholas J. Rushby
Computers in Education as a Resource, Ingersoll College
United Kingdom National Development Programme in Computer-Assisted Learning (NDPCAL)

John Fielden
The Costs of Learning with Computers, an analysis of the NDPCAL, above

Andrew Molner
National Science Foundation, Research in Science Education
The next crisis in American education - computer literacy
Computer and videodisc - intelligent videodisc for science education.

Joseph Lipson
Science Education, National Science Foundation
Need aesthetic and emotional qualities in CAI

Robert Seidel
Human Resources Research Organization (HumRRO), Arlington, Va.
Computer simulations give unique learning, quickly.

Raymond Fox
Society for Applied Learning Technology (SALT), Virginia
Conference on videodisc

WICAT
Orem, Utah
Dustin Heuston
Victor Bunderston (Mr. TICCIT)
Educational systems are "mature", need new technology to increase productivity. Intelligent videodisc is inevitable.

Lester Eastwood
Washington University
Intelligent videodisc, although appealing, faces major barriers like teacher resistance, tight budgets and lack of courseware.

Robert Branson
Florida State University
Calls for user groups to tell videodisc manufacturers what they want.

ABC/NEA SCHOOLDISC Program
Fred Wilhelms
Teachers develop ideas for videodisc and TV people implement them.

J. Andriessen
Phillips Research Laboratories
Medical students liked a trial videodisc course more than slides or film.

Nebraska Videodisc Project
University of Nebraska, Lincoln
Rod Daynes, Director
Educational videodisc R & D
Teachers of tumbling loved using videodisc.
Use for the hearing impaired.

Nicholas Negroponte
Massachusetts Institute of Technology
Media room: multimedia, multisensory input and output under learner's control.
Imaginative uses of intelligent videodisc, map-travelling, making movies modular.

Sesame Place
Lower Bucks County, Pennsylvania
A playpark for kids, by Children's Television Workshop and Busch Entertainment.
Seventy computers designed for kids with educational games that are fun to play.
Joan Ganz Cooney, President, CTW
Joyce Hakansson, Computer Coordinator
Marilyn Rothenberg, Research

QUBE
Columbus, Ohio
Vivian Horner, educational programming
Gerry Jordon, program development
Cable TV viewers may push one of five buttons to polling by the studio

Berks Community Television (BCTV)
Reading, Pennsylvania
Gerald Richter, Executive Director
Interactive community television
TV of, for and by the people.
Open forums on issues, with phone-ins, split-screen.
Students interview about history, produce own shows.

William Rushton
Center for Non-Broadcast Television, New York
Director of Research
Viewer participation on timely topics via public television and cable.

Red Burns
Director, Alternative Media Center, New York University, which started BCTV.
Member, Carnegie Commission on Educational Television, which recommended reorganizing public broadcasting in A Public Trust

Kit Laybourne
Director, Media Probes, New York
Doing TV series to help people understand TV.
Promotes people-produced TV.

John LeBaron
Massachusetts Educational TV
Director, Planning and Development
Television by Children: A Production Guide for Young People, empowers teachers to help children produce their own TV programs.

Peter Dirr
Corporation for Public Broadcasting
Fifteen million American pupils a year use instructional TV somewhat regularly.
Sixty percent of colleges use ITV, especially community colleges.

Saul Rockman
Director, Agency for Instructional Televison, Bloomington, Indiana
Coordinates joint program projects by state and provincial agencies.
Acquires and distributes ITV programs.

University of Mid-America
Lincoln, Nebraska
Donald McNeil, Executive Vice President
Develops and distributes ITV for eleven states.

National University Consortium Project
Dr. Adele Seef
University of Maryland
The first nationwide TV university begins September, 1980.
Courses lead to B.A.

Charles Ferris
Chairman, Federal Communications Commission
Children's programming has changed little in the last six years.
The technologies can transmit a much greater abundance of
diverse programming.

Peggy Charren
President, Action for Children's Television
Newtonville, Massachusetts
Promotes diversity and discourages commercial abuse

Dorothy and Jerome Singer
Family Television Research and Consultation Center
Yale University
Helping children view TV critically
Materials for parents and teachers.

Rosemary Lee Potter
New Season: The Positive Use of Commercial [illegible]
Classroom activities using prime-time TV to teach thinking skills

Linda Kahn
Director of Curriculum Development
Prime-Time School Television (PTST)
Chicago, Illinois
700,000 teachers use PTST teacher g[illegible]
TV programs like Roots and [illegible]

Neil Postman
Teaching as a Conserving [illegible]
TV is today's "first curriculum" [illegible]
schools should thermostatically balance the [illegible]
content

[illegible] Anderson
Washington [illegible]
The more kids watch [illegible]
Disadvantaged children are no [illegible]
than advantaged ones.

[illegible] Salomon
Hebrew Univ[illegible]
A leading theorist [illegible]
Interaction of Media, Cognition [illegible]
Explores the ways a learn[illegible]
fit between the symbol systems of the [illegible]
symbolic representations.

SUMMARY LIST - continued

Richard Clark
Center for Media Research and Development
University of Southern California, Los Angeles
Bridges the gap between research and the application of educational technology.

Wilbur Schramm
East-West Communication Institute, Honolulu, Hawaii
Educator, philosopher and writer on issues about communication and media.

Dean Jamison
Economist, The World Bank
The Costs of Educational Media: Guidelines for Planning and Evaluation
Per-student hour costs for radio: 1 - 5¢; for ITV: 5 - 15¢
Cost analysis is complicated and approximate

Howard Hitchens
Executive Director
Association for Educational ...
Washington
Has overview of development of audio ...
AECT will be publishing a book this fall on media for ...
Eugene Wi...son of the University of Georgia

... Wagshal
Director ...
Spoken input and output of future technology ... less important skill, and education should prepare ... for the ...

... topher Dede
President, Education Section ... Future Society
The costs of conventional education will increase ... of computers in education will decrease

Gagne
Educational Research ... Florida State Uni...
Internationally known for relating ... instructional technology, as he did in Principles ... Design (1979) Gagne sees educational technology lagging behind research's prescriptions that materials (1) make semantic encoding possible by providing larger meaningful contexts and (2) help lear... realize their capacity for "metacognition," for learning how to le...

... Frase
Bell Laboratories
A thorough review ...
defined as science applied to education ... review gi... a backdrop to our survey of uses of hard...

SUMMARY LIST - continued

Dwight Allen

Old Dominion University, Norfolk, Virginia
The new "basics"; learning to use the tools of our time to improve the quality of life. No teacher will complain about having extra moments to read a story with his students while the computer grades a quiz. Government must guarantee technologies for the poor as well as the rich. There is a need for national coordination of accreditation and curricula in a mobil decentralized age induced by technologies

Ralph Tyler

Science Research Associates, Chicago Illinois
This eminent educator puts our discussion in perspective
Educational technologies need to be guided by an understanding of schools, of what teaching is and is not, of why teachers do and do not adopt technologies.
Teachers and technologists must develop programs together
The Secretary of Education should lead a widespread and informed dialogue on educational issues

Frank Norwood

Executive Director
Joint Council on E[illegible]
Educators must help form national [illegible]
JCET assists this with studies and forums.
Some forums have used teleconferencing by satellite [illegible]
JCET offers to help the Department of Education to explore conferences [illegible] for the kinds of public dialogues Tyler urges above

IV. PROJECT DESCRIPTIONS

10,000 Microcomputers for French Secondary Schools

Work of: Jacques Hebenstreit
Chairman, Computer Science
Ecole Superieure d'Electricite
10 Avenue Pierre La Rousse
92 Malakoff, France

Few projects compare in scope to France's first CAI experiment. An even more ambitious plan, now in its initial stage, will be implemented by 1985. While France's highly centralized system of education creates obvious differences from the United States, American educators [illegible] could derive useful lessons from the French experience. These are described by Jacques Hebenstreit in *10,000 Microcomputers for French Secondary Schools*, the highlights of which are as follows.

The first experiment [illegible]

[illegible] goals [illegible] the two [illegible]

- [illegible] the computer [illegible] including programmed instruction [illegible] to the teaching of [illegible] disciplines, and

- to emphasize [illegible] teaching/learning

[illegible] the French [illegible]

[illegible]

[illegible] million was [illegible]

investment costs

[illegible]

[illegible]

[illegible] second [illegible]

additional 5000 teachers [illegible]

Teachers of physics and math were taken in minimal numbers to avoid giving the impression computers can be used only for math and science; stress was put on history, language, and the arts, among others. [We note with interest the stress on the role of computers in the humanities in Humanities in American Life, a report by the Commission on the Humanities to be released October 9, 1980.]

In a move unimaginable in the U.S.A., a standard hardware configuration and software language was defined, created and mandated for use. This imposition of a standardized system allows widespread transferability of programs as well as standardized training.

The second experiment launched in 197[illegible] [illegible] in French schools by 1985 for children ages 11-18. This project again will have teacher training as its cornerstone. Of the 500 courseware packages developed in the first experiment, 70% are ranked by teachers as [illegible] or "fairly good".

[illegible]

Jacques H[illegible].
"10,000 Micro[illegible]"
Compute, July 1980

Telling Turtles to Draw: Learning in a Computer Culture

Work of: Seymour Papert
Project LOGO
Artificial Intelligence Laboratory
Massachusetts Institute of Technology
545 Technology Square
Cambridge, Massachusetts 02139
Tel: 617-253-6214

A child is telling a robot turtle to [illegible] in the last decade privileged to play [illegible] Papert [illegible] The turtle [illegible] a large sheet of paper. It [illegible] which the [illegible] can command to be [illegible] the paper by typing [illegible] by typing "PENDOWN" [illegible] child can tell the turtle to [illegible] steps [illegible] typing FORWARD [illegible] and can tell it [illegible] of degrees as in RIGHT 90 [illegible] dr[illegible] right angle [illegible]

```
PENDOWN
FORWARD 1[illegible]
RIGHT 9[illegible]
FORWARD 100
```

[illegible]

[illegible]

[illegible]

[illegible] 100 [illegible]

```
TO SQUARE
REPEAT 4 [illegible]
```

[illegible] typ

```
PENDOWN
SQUARE
```

Seymour Papert, who developed the turtle and the LOGO language for running it, thinks most work using computers for education has it backwards. What is happening in the sequences described above is that the child is giving instructions to the turtle, not the other way around. In most applications, however, the computer is used to instruct the child, which encourages passivity. This is especially true of the drill and practice brand of CAI, to which Papert's work is diametrically opposed. Instead of being taught by the computer, the child teaches *it* to do what the child wants. Instead of learning about things, the child learns things he can do. [illegible]

What is it the child is learning to do with LOGO? [illegible] the child is learning to do mathematics, [illegible] mathematics [illegible] beneath the content of specific mathematical areas there lies a general set of epistemological [illegible] algebra, calculus, *et al.*

[illegible] example, [illegible]

[illegible]

RE EAT [illegible]

[illegible]

Then she carefully observed what her hand had done. Next she gave names to the elements, calling the vertical line "BIG" and the horizontal "SMALL". Finally, on her own, she told the Turtle in LOGO to do the same as she had.

```
TO GROWSHRINK : BIG : SMALL
1    FORWARD : BIG
2    RIGHT 90
3    FORWARD : SMALL
4    RIGHT 90
5    GROWSHRINK : BIG [illegible] 10 : SMALL [illegible] 10
END.
```

Another concept [illegible] [illegible] [illegible] [illegible] simple parts. Instead of [illegible] [illegible] learns to begin with an arc [illegible]

Debugging is al[illegible] [illegible] might first define a procedure for making [illegible]

```
TO CIRCLE
FORWARD 1
RIGHT 1
CIRCLE.
```

[illegible]

[illegible]

Notice that with the turtle it is the child who initiates the action, not the turtle. Papert follows Dewey and Piaget in feeling that children are active discoverers of the world, making sense of the world at their own pace in their own way.

Papert has provided such environments for kids for over a decade, including helping children with multiple sclerosis extend their physical and mental powers. The most extensive study of the use of LOGO was done in a Brookline, Massachusetts school in 1977-78. All sixth grade students had between 20 and 40 hours of hands on experience with a computer [illegible]. Results for sixteen students were documented in detail.

Papert argues that every first grader [illegible] computer [illegible] keep, to use like a pencil. Papert [illegible] children [illegible]

[illegible]

Some References

This fall, Basic Books is going to publish Seymour Papert's book, Mindstorms: Computers, Children, and Powerful Ideas, a reflection on the last decade's work by Papert and his LOGO associates, a discussion of developmental the..., and a vision of the future in which kids learn by "teaching" computers.

[illegible]
Journal o[illegible] Structu[illegible]al Learni[illegible]
Educational theory.

[illegible]
Teaching [illegible]bo[illegible] Mat[illegible]em[illegible]ti[illegible]s"[illegible] The [illegible]
here are the best way to experie[illegible]ce wh[illegible]. Pa[illegible]
is after

[illegible]
as an [illegible] in D[illegible] [illegible] Psychology.
A speech to be presented this fall, talking about the ways a compute[illegible] culture will put in question no[illegible]io[illegible]s about intellectual develop[illegible]

[illegible]
American Educat[illegible] [illegible]
LOGO for cerebral palsy victims

[illegible]

Is CAI Effective? A Survey of 65 Evaluations

Work of: David V. Thomas
University of Iowa
Iowa City, Iowa 52240
Tel: 319-353-2121

One of the most complete surveys of studies of the effectiveness of Computer Assisted Instruction was recently done by David Thomas for the Spring 1979 AEDS (Association for Education Data Systems) Journal. He reviewed 65 studies of CAI use, most in secondary and elementary [illegible]. The clear pattern that emerges is that CAI is both effective and fast according to most evaluations and despite [illegible] Thomas himself [illegible] during his conversations with us. Among the reservations: many studies did not clarify what approach to CAI was used, [illegible] Thomas [illegible] drill and practice and more interactive [illegible] most measures of effectiveness relied on standard achievement [illegible] other nonstandard and noncomparable test.

[illegible] Thomas' findings are the following:

1) [illegible] considerably less time than students in [illegible]. This time-saving is the most important of Thomas' [illegible] early days of CAI, its proponents aimed for high [illegible] cost, and did not speak of saving time. But time savings [illegible] expected in an approach like CAI that accounts for individual differences. In 16 out of 17 studies, time savings were found. In the one exception, students using CAI took longer (though not significantly), but had more data to work with.

2) Students [illegible] CAI [illegible] standardized tests and seldom more lower.

3) Students using CAI [illegible] of instruction as often as [illegible]

4) Students using CAI retain what they learn as well as non-CAI students, according to four studies and one survey.

5) The cost of CAI is approaching that of conventional instruction. However, costs are hard to quantify and compare, so existing comparisons are tentative.

Thus according to a composite of the evaluations, CAI seems comparable to conventional methods in cost, retention, and attitudes. It is somewhat better in standard achievement, and significantly quicker. If costs of CAI decrease as expected, the implications for education will be substantial. Any discussion of these implications would be [illegible] by David Thomas [illegible] CAI's effectiveness to date.

Reference

Da[illegible] Effect[illegible] of Computer-Assisted Instruction in Secondary Schools", AEDS Journal Vol. 12, No. 3, Spring, 1979, pp 103-116

Evaluating PLATO

Evaluations
c/o Donald L. Alderman
Educational Testing Service
Princeton, New Jersey 08541
Tel: 609-921-9000

The Plato Project
c/o Don Bitzer
Computer-Based Education Research Laboratory
University of Illinois
Champaign/Urbana, Illinois
Tel: 217-333-1000

PLATO (Programmed Logic for Automated Teaching Operations) is presently the most extensive computer-based education system in existence. A very large Control Data Corporation computer allows more than a thousand users at separate high-resolution terminals to be simultaneously interacting with any number of tens of thousands of hours of courseware in a large variety of subjects. The system can keep records on student progress and can allow people to write courseware. PLATO is the "Cadillac" of computer based education.

Nonetheless it has not always fared well in evaluations. [illegible] Testing Service did a five year evaluation, reported in 1978, of the use of PLATO for fourth to sixth grade math and for first grade and kindergarten reading. In math, [illegible]

Another major evaluation of PLATO by E.T.S., reported in 1977, was of a system implemented in five community colleges. The main conclusion: PLATO had no significant impact on student achievement. However, both students and instructors had positive attitudes toward the system. In the instructors' case, positive attitudes were attributed to their being full participants in its local implementation and use.

Professor Robert Caldwell of [illegible] developed much of the PLATO [illegible]ware in the language arts and [illegible] that [illegible] learning basic reading skills with [illegible] average more than one grade improvement in [illegible] hours. His reports, however, [illegible] enough data for his findings to be [illegible] assessed.

Control Data Corporation [illegible] skills programs in [illegible] with the PLATO system.

Some References

[illegible]
Judith Morgan, [illegible]
Educational Outcome Evaluation: [illegible]
Educational Testing Service, November, 1978

[illegible]
of the PLATO IV Computer Based Education System In the Community College: Final Report, June, 1977

[illegible]
Computer Based System [illegible] Instruction for Adult Non-Readers. AEDS Journal, Fall, 1979

Evaluating TICCIT

TICCIT System Evaluation
c/o Donald L. Alderman
Educational Testing Service
Princeton, New Jersey 08541
Tel: 609-921-9000

As part of a 1972 grant from the National Science Foundation, the Educational Testing Service evaluated the MITRE Corporation's Time-shared, Interactive, Computer-Controlled Information Television system, known as "TICCIT". The TICCIT system was based on time-shared "mini-computers" that used television sets in contrast to the large, special-screen PLATO system. TICCIT was tested in two community colleges on programs in English (1976-77) and in math (1975-76).

Results were mixed. Only 16% of TICCIT users successfully completed their courses compared to a 50% completion rate for lecture sections. For those who finished, however, achievement scores were significantly higher in math and marginally higher in Englsih. Student reaction was mixed, faculty acceptance "not sure". Evaluators' overall conclusion: "Widespread school adoption of CAI and expectations of significant increases in school productivity would be premature."

Some References

"Evaluation of the TICCIT Computer-Assisted Instructional System in the Community College", Educational Testing Service, Princeton, New Jersey, September, 1978

Project Solo: Learning Rather Than Instruction

Work of: Tom Dwyer
Project Solo
Computer Science Department
University of Pittsburgh
Pittsburgh, Pa. 15260
Tel: 412-624-6355

Tom Dwyer criticizes most Computer-Assisted Instruction (CAI) for falsely assuming, "(1) What we now call instruction is the best way to promote human learning, and (2) the role of technology is to automate this instructional process...." He questions the first assumption, feeling that ultimately learning is something each person does "solo" (hence the name of his project). For example, when helping someone learn to fly, even when flying "dual", the instructor's primary task is not to tell the students how to land the aircraft, but to help build their own model of the process.

Tom Dwyer has been applying that principle for over a decade by inventing ways of using computers to create environments in which students can learn "solo". For his humanistic use of computers, Dwyer is one of the most widely respected persons in his field. Now he is applying the principle to one of the major issues confronting educational computing -- how best to encourage the development of imaginative courseware. He fears that "the 'small is beautiful' effect that made microcomputering possible in the first place [may] be undone by a 'big means mediocre' syndrome" of giant publishers seeking mass markets. To counter this, he urges people to form a lobby to help publishers build on imaginative ideas, and to themselves become writers of software and books, thus promoting a diversity of innovative ideas.

Reference

Tom Dwyer, "Books as an Antidote to the CAI Blues, or Take a Publisher to Lunch", Byte, July, 1980

The Computer as Intelligent Coach

Work of: Learning Research Group
Xerox Palo Alto Research Center
3333 Coyote Hill Road
Palo Alto, California 94304
Tel: 415-494-4000

c/o Allen Kay
John Seely-Brown
Ira Goldstein

Xerox has gathered some of the most seminal people doing research in computers and learning. Allen Kay, director of the Learning Research Group, has been instrumental in developing computer languages that are both dynamic and easy to use.

Two people now at Xerox, John Seely-Brown amd Ira Goldstein, are leaders in the attempt to develop computers as intelligent tutors. Instructional computers now are "unaware" of what the user is doing and why he or she may be running into trouble. Seely-Brown and Goldstein are trying to change that.

John Seely-Brown is considered by some to be a leading innovator in the application of artificial intelligence to instructional uses of computers. Because his field is unexplored, he has begun with small prototype systems in selected domains of knowledge. Thus, he helped develop SOPHIE, a Sophisticated Instructional Environment for teaching electronic trouble shooting; BUGGY, to assess procedural skills in math; and BLOCKS, which helps students learn to make reasonable inferences in logical games played with attribute blocks. These prototypes have helped clarify the characteristics an intelligent tutoring system might have. Thus, one approach has been to supply the computer with a map of all the paths one might take in solving a problem in subtracing large numbers. The computer can then compare that map with the path a student actually takes, allowing a diagnosis of where the student has lost the way. Then the computer can offer the student more helpful advice based on insight into the nature of the task and the nature of the student's model of it.

Ira Goldstein, an exceptionally talented young computer scientist who has worked with Papert at MIT, is working in a similar vein to develop computers that can serve as "coaches". The coach has an evolving model of the problem-solving skills needed for someone to perform well on a particular task, and compares that model with the actual performance of the student. If the student's actions are too far away from the model, the computer then coaches the student.

One of Goldstein's main aims in this is to learn more about how people solve problems. A student's interactions with a computer coach are, in some ways, easier to observe than interactions with teachers.

The work of Seely-Brown and Goldstein is highly theoretical, but it is already proving to be of at least some practical worth. For instance, Seely-Brown has used his "BUGGY" approach successfully to teach teachers principles of "de-bugging" (diagnosing and correcting errors) and to train teachers to debug errors in their students' thinking.

The real pay-off, however, for the work of Seely-Brown and Goldstein is likely to be far in the future. But when the payoff comes, they are likely to be recognized as among the important innovators of our era.

John Seely-Brown and Richard R. Burton, "A Paradigmatic Example of an Artificially Intelligent Instructional System," International Journal of Man-Machine Studies

John Seely-Brown and Richard R. Burton, "Diagnostic Models for Procedural Bugs in Basic Mathematical Skills," Cognitive Science, Vol.2, pp 155-191.

Ira Goldstein, "Developing a Computational Representation for Problem-Solving Skills" in Problem-Solving and Education: Issues in Teaching and Research, edited by David Turna and Frederick Reif, Laurence Erlbaum Associates, Hillsdale, N.J., 1980. Describes uses of a computer coach.

I.P. Goldstein and Seymour Papert, "Artificial Intelligence, Language, and the Study of Knowledge," Cognitive Science, Vol. 1 (1) pp. 84-123. They doubt that a single general principle of tutoring will be found powerful enough to handle all domains of knowledge.

From Drill and Practice to Socratic Dialogue?

Present Realities and Future Plans for Computer-Assisted Instruction

Work of: Professor Patrick Suppes
Institute for Mathematical Studies in the Social Sciences
Ventura Hall
Stanford University
Stanford, California 94305
Tel: 415-497-3113

and Computer Curriculum Corporation
Palo Alto, California

Patrick Suppes, one of the leading innovators for the last 20 years in Computer-Assisted Instruction (CAI), is also supportive of the emerging movement towards ICAI -- Intelligent Computer-Assisted Instruction. While Suppes is best known for his work in CAI drill-and-practice courses in basic skills, he also foresees technologies that would make possible an intimate dialogue between groups of a dozen or so students and a computer-simulated Socrates, for literally millions of students.

Were such a shift from drill-and-practice CAI to Socratic ICAI to be realized, it would compel educators to rethink the entire concept of schooling.

Elementary Drill-and-Practice CAI: Through the Computer Curriculum Corporation, Suppes has developed 15 CAI drill-and-practice courses in subjects like math, reading, and language skills. In 1978 more than 150,000 students in 24 states were taking such courses on a daily basis. Perhaps best known of these are a mathematics course for grades 1-6, a reading practice course for grades 3-6, and language arts lessons for grades 3-6.

These courses have been evaluated in a number of ways, for several different populations, and most evaluations agree that these drill-and-practice courses have usually been as effective as traditional methods and are occasionally superior. The Educational Testing Service recently released preliminary findings of an evaluation which indicates that the CAI math course was significantly more effective than non-CAI courses. However, smaller effects, and on occasion negative ones, were recorded for the reading and language arts programs. Of these two, the courses were more effective in raising language arts scores than reading scores.

Improvements have now been made: Computer Curriculum Corporation's new "Reading for Comprehension" course has largely replaced the early one used in the ETS evaluation. It is reasonable to expect further improvements in the effectiveness of these CAI courses, and it is also widely accepted that their cost will drop below that of standard delivery systems. Thus there is likely to be an increase in the use of CAI of the type which Suppes and the Computer Curriculum Corporation have developed.

College-Level CAI: At Stanford's Institute for Mathematical Studies in the Social Sciences, Suppes and his colleagues have implemented courses in a variety of subjects, including logic, set theory, Slavonic languages, programming languages, Chinese, and music. While these are necessarily the products of collaborations, many bear the mark of Suppes, who has published texts on logic and axiomatic set theory, as well as a variety of articles on semantics as well as educational theory. These CAI courses are taken by many hundreds of Stanford students each semester.

A systematic evaluation has been done on only two of these courses -- Introduction to Russian and Introduction to Logic. The CAI Russian courses showed fairly strong superiority to traditional methods. This is counter to the usual finding that the method of instruction at college makes little substantial difference in achievement. The CAI logic course was less impressive -- its performance was slightly better than a lecture course in logic, but not significantly so.

An important, often overlooked, implication is that CAI is effective not only for heavily enrolled courses but for sparsely enrolled ones as well. For the heavily enrolled courses, it can deliver individually paced instruction in a manner which students have indicated they prefer to lectures. For sparsely enrolled courses, CAI offers instruction which might otherwise be cut because of underenrollment. Suppes feels this is critical in preserving the university's role of transmitting a complete range of knowledge, even in an age of cutbacks.

Computer-Simulated Socratic Dialogue: At the Stanford Institute, Suppes not only has developed immediately useful courseware, but also has conducted early research on two of the features indispensable to computer-simulated Socratic dialogue -- computer generated speech and natural language processing. A system called the "microprogrammed intoned speech synthesizer" has been developed by which a computer can "speak" words, with intonation. As for natural language processing, progress is being made on language acquisition and semantics for relatively formal fragments of English. Relative to the vast complexity of real language, results remain restricted. Nonetheless, Suppes is hopeful that within one to two decades computer programs will be able to process language with sufficient skill and sophistication for dialogue.

For the future, Suppes foresees a growth in CAI use of about 2% per month, given a likely decline in CAI costs and a likely rise in conventional educational costs. He sees wide use of computers in the home by the year 2000, raising questions about accreditation of CAI learning done at home. New technologies such as video disks may offer a variety of new programming possibilities for CAI. In Suppes' judgment, one of the most promising approaches is "intelligent CAI" by which the computer constructs a model of how the student thinks, tests that model, revises it, and uses it to help students overcome pitfalls in their thinking. Such ICAI would be a step towards computer-simulated dialogue worthy of the name of Socrates or Plato.

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- Robert Davis, D. Jamison, M. Ragosta, Warren Jahnke, R. Woodson, Paul Holland, H. Levin, "Computer Assisted Instruction: A Longitudinal Study" an AERA presentation, April 1980.

Pioneering Work in Philadelphia: Sylvia Charp

Work of: Sylvia Charp
Director of Instructional Systems
The School District of Philadelphia
Fifth and Luzern Streets
Philadelphia, Pennsylvania 19140
Tel: 215-229-9492

For fourteen years, Philadelphia has been a leader in using computers in schools, thanks to the work of Sylvia Charp. Today, 50,000 students in 30 schools use 240 terminals and 55 microcomputers to take individualized instruction in 10 programs. Subjects include vocational information, problem-solving, math, and computer literacy, among others. An especially interesting program is one in which 14,000 students work in partnership with their parents, at home, on personalized story activities and mathematics drill.

Sylvia Charp's Introduction to the Philadelphia
Division of Instructional Systems, April, 1980

Resource Person on Microcomputers

Work of: Karen Billings
Director
Microcomputer Resource Center
Teachers College
Columbia University
New York, NY 10027
tel: 212-678-3740

Karen Billings is co-author with David Moursand of Are You Computer Literate?, and directs a microcomputer resource center serving large numbers of teachers. Though an optimist about the long-range potential of microcomputers in education, she is a realist about current difficulties. She recognizes the reservations many teachers have about computers, and cautions that to be useful they must be used in a way that fits the teacher's philosophy and the school curriculum. This is a perspective she has gained as a resource person to a considerable number of schools and teachers.

Reference

Karen Billings, "Microcomputers in Education: Now and in the Future", Microcomputing, June 1980.

The People's Computer Company

Work of: Robert Albrecht
People's Computer Company
1263 El Camino Real
Menlo Park, California
Tel: 415-323-3111

Bob Albrecht is turning Menlo Park into the first "Computer Town, U.S.A." Albrecht's vision is that computers be everywhere -- in homes, on streets, in schools -- and that the computers be for the people and controlled by them.

Albrecht has been having fun with computers and people for two decades. His People's Computer Company has spawned a variety of creative uses of computers. Albrecht has been associated with a number of alternative computing magazines, including most recently Recreational Computing.

Though an old-timer to the trade, he keeps changing with the times. Once a supporter of the language BASIC, he has been shifting support to languages like PILOT and TINY BASIC which are easy for kids to learn.

Albrecht sees computers as having an impact in the home before the school, but he thinks the potential impact on education could be large. Used properly, computers could let teachers do what he thinks they should-- teach individuals and small groups. An impact of growing use of computers in homes will be that children will enter school with widely differing levels of knowledge, to which teachers will need to adjust.

Reference

"Computers: Worlds of 'If' for Children to Explore", an interview of Albrect by Bill Langeres in Interface Age, September, 1978.

Computer Literacy and Its Importance in an Information Age

Work of: Arthur Luehrmann
Director of Computer Research
Lawrence Hall of Science
University of California
Berkeley, California 94720
Tel: 415-642-4193

Arthur Luehrmann was one of the early developers of computer use at Dartmouth College. At Lawrence Hall of Science, he has developed innovative ways of using computers in a museum setting. Now he is going beyond museums, bussing bushels of apples (microcomputers) to schools. He thinks computing is important because it gives children a chance to carry out a level of intellectual activity difficult in other modes like reading, writing, and doing arithmetic. With computing, children can represent problems by writing a mathematical model, then test and revise their intellectual model.

As for the U.S. at large, Luehrmann is one of many who argue that for the United States to cope wisely with an emerging information age, there needs to be much broader computer literacy. That will require large investments, from both the private and public sectors. But computer literacy, he insists, is not knowing about computers as much as it is doing things with them.

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Arthur Luehrmann, "Computing Illiteracy -- A National Crisis and a Solution for It", Byte, July, 1980.

A panel discussion with Luehrmann, Papert, Bork, and Johnson, Pipeline, Summer, 1980

Minnesota: Every School Computerized

MECC (Minnesota Educational Computing Consortium)
2520 Broadway Drive
St. Paul, Minn. 55113
Tel: 612-376-1122

Dr. John E. Haugo, Director

MECC is the "Mecca" of cooperative use of educational computing. Established in 1973, it coordinates and serves virtually all Minnesota's schools, colleges, and educational agencies. Its purpose is to help educators use computers for their educational purposes.

Its figures are impressive. It operates one of the world's largest educational time-sharing system, giving 96% of Minnesota's more than one million students access to about 1,000 educational programs. It has installed over 1,000 Apple II microcomputers in Minnesota schools, and supports them with over 150 free programs. It does research, development, and evaluation, most recently receiving a two-year grant from the National Science Foundation for $286,000 to develop and distribute twenty-five learning packages aimed at computer literacy. It operates a management information system to help schools handle information about students, schedules, employees, and finances. It is governed by a state-wide board and administered by a staff of 75.

For those both attracted to the centralized model France's promotion of computers in education and also recognizing the decentralized nature of U.S. education, MECC is perhaps the best model available of a concerted effort to use computers effectively for education.

Available Resources

Folder of MECC material, including
Dateline

Profile of an Innovative Educator

Work of: Professor Daniel Klassen
St. Olaf College
Northfield, Minnesota 50057
Tel: 507-663-2222

Dan Klassen has written two dozen social science simulations with Ludwig Braun's Huntington Two Project, and has collaborated with Judith Edwards and other at the Northwest Regional Educational Laboratory in writing Computer Applications in Instruction: A Teacher's Guide to Selection and Use. He has supervised research and development projects at the Minnesota Educational Computing Consortium, and now teaches social science. He offers a humanist view of the use of computers.

Reference

"Profile of an Innovative Educator:
Dan Klassen", Pipeline, Fall 1978

National Centers for Personal Computers

Work of: Ludwig Braun
Director,
Laboratory for Personal Computers in Education
State University of New York at Stony Brook
Stony Brook, NY 11794
Tel: 516-246-8424

In the mid 1960s, Ludwig Braun was offered the free use of a time sharing computer by the General Electric Co. and Braun began to teach his undergraduate students how to program. After one month's bill ran over $8,000, G.E. had to curtail the offer. Braun later found out that his students had hidden under desks just before he locked up so that they could use the terminal all night! He says, "I have never since made any effort to keep students from computing."

Far from that, he has been one of the leaders in actively providing opportunities for students to use computers and in removing barriers to their use. In the late 60s, with the help of the National Science Foundation, he started the Huntington Computer Project, working with 80 teachers in 10 high schools in Huntington, Long Island. From this project they learned that teachers need adequate training and manuals, and that "some of the best programmers in the world are students." They also learned that simulations held great promise and have since developed [illegible] simulations (with good manuals), in biology, social studies and physics.

An example of one Huntington simulation ...

[illegible]

to develop, are now published by the Digital Equipment Corporation. They are among the most widely used computer materials at the pre-college level, probably having been utilized by hundreds of thousands of students.

Braun sees the announcement in January 1975 of a $400 microcomputer as the opening "gun" in the microcomputer revolution. He was quick to join the revolution, seeing benefits of plummeting costs, portable size, and reliable hardware. With the help of the Sloan Foundation in 1975, he established the National Coordinating Center for Curriculum Development, which has placed PET microcomputers in three high schools with mostly minority students. They use available courseware to learn programming, and to run instructional computer games that are highly motivating. Because these PET microcomputers are small, students are being allowed to take them home overnight, and to use them in youth programs on weekends. One measure of the program's success is that two of these schools have ordered more microcomputers, despite the schools' budgetary constraints.

Braun is keenly aware that the microcomputer [illegible] many barriers to overcome. In conversation and correspondence [illegible] has identified the following problems, among others:

1) Courseware is sparse, of mixed quality, and [illegible]

2) We really do not [illegible] the [illegible] intellectual development

3) The choice of equipment [illegible]

4) Teachers are [illegible] training

5) [illegible] efficient [illegible] instruction

These problems are [illegible]

addressed quickly and systematically to unlock the potential of computers for education. He has urged and assisted Congressman Downey of New York draft a bill (H.R. 7459) to establish one or more national centers to address the above problems. The bill is for $4,000,000. Braun points out that the governments of France,* Great Britain, and West Germany have all undertaken similar efforts, and that the United States runs a risk of falling behind if computers are not made a part of our education. Braun does not see these centers as permanent entities, but as temporary devices to "prime the pump"

"Priming the pump" is important because the lack of adequate courseware is the largest single barrier. Though there are many good computer curricula materials available (through the efforts of people like Braun), there are still huge areas where the material is non-existant or of poor quality. For personal microcomputers, the courseware situation is especially bad. [illegible] cottage industry is springing up to provide courseware, but Braun finds [illegible] such courseware to be of poor quality. And good courseware is often known only locally, having no national dissemination facilities. Eventually commercial publishers may solve these problems, and already McGraw Hill, Scott Forsman, and others are looking into such possibilities. But [illegible] most are not ready to make the necessary investments. Braun [illegible] $100 000 000 is needed for all K 12 curricula. [illegible] small at this time [illegible] there is no courseware [illegible] market. To break that [illegible] Braun proposes [illegible] national centers [illegible]

*[illegible]

courseware. Such centers should be charged with producing a range of high quality courseware to encourage schools to adopt computers and improved courseware. Once a market had been established, private publishers would either support or absorb the centers. The first step is the "priming-of-the-pump". Without it development will continue to be slow, haphazard, and of poor quality.

Some References

By Ludwig Braun:

"An Odyssey Into Educational Computing"
This gives a history of Braun's work, and an appendix describing the simulations and other courseware developed in his projects.

Letter to John McClellan, listing problems that must be addressed and people who could discuss them if the Department of Education held seminars.

[illegible]
Imperative fo. the 1980s", Byte, Jul [illegible]
As guest editor for this edition of Byte, B[illegible] argues that federal support of computer-rel[illegible] education could reverse score declines, strengt[illegible] the U.S. in a computer age, allow computers to [illegible] the tools of the poor as well as the rich, and increase the productivity of the otherwise "ma[illegible] or stagnant educational industry Braun includes a list of key innovators.

[illegible]
Personal Computing, [illegible] 197[illegible]
Overview of key computer educatio[illegible] the problems we face, with attenti[illegible] a microcomputer

"Some Bases for Choosing a Computer System: Suggestions for Educators", Journal of Educational Technology Systems, Vol. 8 (1), 1979-80. A guide for educators, and the inadequacies of cost/benefit analyses. N.I.E. supported.

"A Proposed National Center for Personal Computers in Education"

By Congressman Downey of New York.
"H.R. 7459, A Bill ...to provide National Centers for Personal Computers in Education

By Digital Equipment Corporation and [illegible]
"POLUT" -- An example of a manual of a simulation of water pollution.

With Robert M. Aiken
"Into the B[illegible] [illegible]ith Mi[illegible]
Education", July, 1980, Computer [illegible]

The Computer as Glass Box

Work of: Professor Howard A. Peelle
Director
Instructional Applications of Computers
School of Education
University of Massachusetts
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Tel: 413-545-0496

For most students exposed to Computer Assisted Instruction, the computer is a "black box" whose inner workings are a mystery. Howard Peelle takes the black box off and puts a "glass box" on. He lets the students view computer programs, as well as see how the programs behave in action.

The programs are designed to be short and easy to understand. [illegible] Peelle chooses to write the programs in APL, an elegant and powerful language which Peelle has found to be easy for fifth graders to learn and useful for sophisticated professional programmers. Other languages like LOGO, BASIC, and SMALLTALK are also suitable for the glass box approach.

Peelle uses his approach with teachers, undergraduate [illegible] students [illegible] the inner workings of a variety of [illegible] instructional computing, [illegible]

[illegible]

of branching according to a response. Most important, it gives a model of how a computer program can be written simply, clearly, and efficiently. When students go on to write programs of their own, such models are useful guides.

In the process, students come to view the computer as an intellectual tool which they can understand and program themselves, rather than as a black box dispensing materials in mysterious ways.

This does not mean, however, that Peelle pushes the glass box approach to the exclusion of others. In workshops with teachers, and with undergraduates and graduates in his Instructional Applications of Computers Program, he points to other valid uses of the computer like simple drill and practice, tutorials, simulations, games, problem solving, artistic productions, testing, and instructional management. But throughout he retains the sense that computers are for people to control, not for controlling people. By now a decade of his students and teachers have come to feel more at home with computers. This is surely helped by those elegant little model programs students have viewed in Peelle's "glass box."

Some References

Howard A. Peelle
Glass Box, *Personal Computing*
October, 1979

[illegible]
Applications of Computers Using APL, forthcoming

Interactive Computer-Based Learning

Work of: Professor Alfred Bork
Director, Educational Technology Center
University of California, Irvine
Irvine, California
Tel: 714-634-6011

In 1959 Alfred Bork began using a primitive computer in Alaska on an occasional basis to demonstrate principles of physics to his classroom students. By 1978 at the University of California at Irvine he was using 25 graphic terminals to teach physics to hundreds of students. As many as 57% of the Irvine students used computers during their four year program. By the year 2000, in Bork's view, there will be tens of millions (his projection, [illegible] million) of stand alone personal computers in homes, offices, and schools, with some coupled to the vast storage capacities of optical videodisks. Whether these will be giving pedagogically sound [illegible] is an open question.

revolution is likely to benefit from lessons learned from a decade of Bork's experimental projects at Irvine. With more than $1,500,000 from the National Science Foundation, Bork and his associates have developed computer-based learning materials, initially in physics and subsequently in other science courses. Two features are prominent in these materials -- they are highly interactive, and they are highly graphic. This distinguishes them from much other CAI, which, like Suppes' early work, focuses on drill-and-practice in a largely alpha-numeric mode.

An example of interactive graphics in one of Bork's physics classes is a series about magnetic fields. The terminal shows a wire from a battery to a bulb with a compass nearby. When the "current" is flashed on, the student is asked to note the effect on the compass needle, which points in a new direction. Then the student is encouraged to move the compass around the screen with a cross hair system, observing the pattern of the needle's reaction.

Most students speak favorably about such [illegible] [illegible] few computer terminals available to meet the demand. Evaluations by physics teachers has often been glowing, though some maintain that CAI will never be able to provide the subtleties and excitement of a good teacher. One formal evaluation of CAI at Irvine was done by [illegible] of Be[illegible]ley, who [illegible] [illegible] [illegible] [illegible] final exam [illegible]

[illegible] Bork [illegible] great possibilities and [illegible] computer systems [illegible] [illegible] interactive graphics [illegible] rate that costs are dropping, it is reasonable to expect such systems to be available for below a thousand dollars by the mid 1980s, a price well within the range of most schools, libraries, and many individuals. (Less sophisticated CAI is being run today on computers costing about $800).

But computer hardware is only part of the picture -- good courseware is needed and hard to produce. Bork sees the development and distribution of courseware as the major bottleneck for computer-based learning. As for who will produce the material, he tends to see a variety of sources including universities, computer vendors, educational publishers, new companies like the Computer Curriculum Corporation, new organizations similar to the Open University and newly created national centers. In conversation, Bork told us his concern that courseware development not be left solely to those less concerned with quality of instruction than with quantity of profit. He would like the U.S. to follow the suggestion made by the Carnegie Commission on Higher Education, and endorsed by some congressmen, for the establishment of [illegible] centers for the production and dissemination of courseware.

Another model that appeals to Bork is that of Great B[illegible] [illegible]ersity. At about $1,000,000 per course, Bork feels it is within the government [illegible] to establish [illegible] system of [illegible] programs for wide use by all segments of the nation.

As [illegible] for authoring courseware, Bo[illegible] [illegible]

[illegible]

a large scale, systematic effort in some ways similar in organization to textbook publishing. A team of first-rate dialogic teachers would create a rough flowchart of the messages and graphics they want to use to present their material. The teachers' ideas would not be restricted by pre-set templates or technological constraints. Then where necessary an editor would improve language and logic. Designers would then create the graphics needed. Programmers would devise the logic and write the programs, using high level languages and aiming at easy revisability. Then the program would be tried out on experts and teachers, and their feed back would lead to further revisions. Finally, would come marketing and distribution for use by [illegible]

A prospect that intrigues Bork is the marriage of the interactive capacity of the computer with the visual storage capacity of videodisk, to create "intelligent videodisk." He warns against limiting videodisk to the functions of old media, and encourages synergistic use of the two technologies.

Bork feels the implications of computer-based learning and intelligent videodisk for education are enormous. CAI's self-pacing ability did open the possibility of students beginning and ending instruction at any time, [illegible] ing into question current scheduling [illegible] college which has all students doing the same thing at the same time [illegible]

[illegible]

A CONDUIT for Courseware

CONDUIT
100 LCM Building
The University of Iowa
Iowa City, Iowa 52242

Work of: James W. Johnson, Director
Harold Peters, Associate Director
Tel: 319-353-2121

As the price of computer hardware has fallen dramatically, many observers have felt that the single most important remaining barrier to instructional computing is the lack of high quality curriculum materials. CONDUIT is one of the most important organizations in trying to overcome that barrier. Its basic mission is the widespread dissemination of computer based materials for higher education.

Originally funded by the National Science Foundation and [illegible] supporting, CONDUIT searches out instructional materials, evaluates [illegible] educators and technical experts, selects the best, documents and packages them, and distributes them through a catalog and order system. [illegible] catalogue lists about 90 such packages [illegible] from $5 to $125 [illegible] with designs for [illegible]

[illegible]

National Science Foundation for three years, the project will examine graphic materials and measure the difference in instructional effectiveness through the use of graphics, color, and audio.

The second project is identifying, testing and distributing 35 microcomputer instructional packages. Most of CONDUIT's work in the past has been with time-sharing systems; here they examine the exponential growth in microcomputer courseware. The project, funded by the Fund for the Improvement of Post-Secondary Education, will also help authors of microcomputer software share materials and approaches to development. This continues a long-standing commitment of Peters and Johnson, who have written a useful Author's Guide.

In early 1979 CONDUIT sent questionnaires to department heads in ten different disciplines throughout the U.S. Their conclusion: "The instructional use of computers, despite years of [illegible], is still [illegible] low in higher education." [illegible] 50% of department heads expect [illegible] increase the use of instructional computing [illegible] the next three years. [illegible] for a change in the future will be software. The major [illegible] was lack of faculty training.

[illegible]

This includes [illegible] of department [illegible] activities

Author's Guide [illegible] CONDUIT [illegible]
Packaging Review [illegible] CONDUIT, 1980.

Resource Person for Microcomputer Software and Teacher Information

Work of: Dr. Judith B. Edwards
Director
Computer Technology Program
Northwest Regional Educational Laboratory
Portland, Oregon 97200
Tel: 503-248-6800

Judith Edwards has helped deliver education to remote villages in Alaska using computers and narrow-band telecommunications. As a former director of the Educational Telecommunications for Alaska project, she has developed unique ways of using computers and video disks via satellites. She thinks "the current need is not too different from the sixties, with teachers' needs for knowledge of and access to instructional computing software continuing to hold a high priority." To meet this need, she designed a clearing house called "MicroSIFT", (Microcomputer Software and Information for Teachers). The project began operation in 1980 at the Northwest Regional Educational Laboratory under a three-year grant from N.I.E.

She supports the establishment of a National Commission for the study of scientific and technological applications of information technology in education.

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Judith B. Edwards, "MicroSIFT: Clearing The Way", The Computing Teacher, April-May, 1980.

"Using Technology to Enrich the Learning Experience: A Profile of Judy Edwards", CONDUIT Pipeline, Spring, 1978.

J. Edwards, Norton, Taylor, Weiss, Van Dusseldorp, "How Effective is CAI? A Review of Research", Educational Leadership, Vol. 33, November, 1975, pp. 147-153. Supplementary CAI gives higher achievement than traditional methods.

NDPCAL: Great Britain's Great Experiment

Council for Educational Technology
3 Devonshire Street
London, W1N 2BA, England

c/o John Fielding, co-author of

The Cost of Learning with Computers:
The Report of the Financial Evaluation of the
National Development Programme in
Computer Assisted Learning, (1978)

The British National Development Program in Computer Assisted Learning ("NDPCAL") was a $5 million experiment carried out from 1973-1979. Like the program in France, more than half (60%) of its budget was used for teacher training and package-writing. Details of this extensive program can be found in the report cited above, published in paperback by the Council for Educational Technology.

Educational Technology in Japan

Time did not permit an evaluation of the state-of-the-art of educational technology in Japan. Sources of information are:

Professor Mitsuru Miyata
author, Plan for an Information Society:
A National Goal for the Year 2000
Tsukuba University
Tendai 1-1-1
Sakuramura, Nihihigun
Ibara-Kiken 300-31, Japan

Professor Takashi Sakamoto or
Professor Kunihiro Suetaka, director,
Educational Technology Development Center
Tokyo Institute of Technology
12-1 Ohokayama
2 Chome Meguro-ku
Tokyo 152, Japan

Professor Hiromitsu Mata
National Institute for Economic Research in Tokyo

(1980/81 guest scholar):
Stanford University
c/o Institute for Research on Finance and Governance
Stanford, California 94302
Tel: 415-497-9194

Evaluating Computer Effectiveness

Work of: Dr. Robert J. Seidel
Director
Human Resources Research Organization
Eastern Division
300 N. Washington Street
Alexandria, Va. 22314
Tel: 703-549-3611

Robert Seidel has spent a decade evaluating computers as educational tools. One evaluation done for the Office of Technology Assessment of computer simulation and testing in medical education found time savings (up to 50%), and provision of training not available in conventional methods. It was less clear if there were savings in cost. Seidel rejects cost/benefit analysis when evaluating many applications of computers in education. Because the computer provides new benefits not available before, he thinks it more useful to talk of "tolerable costs" -- i.e., those a school is willing to bear for anticipated benefits.

Some References

Robert J. Seidel "It's 1980: Do You Know Where Your Computer Is?" Phi Delta Kappan, March, 1980, pp. 481-485.

Computer Technology in Medical Education and Assessment, Office of Technology Assessment, Congress of the United States, Washington, D.C., September, 1979. Summarized in Braun's Byte article

Exemplary Institutions in Academic Computing HumRRO, Washington, D.C., January, 1978. From a large survey, 106 models identified.

Elevating Educational Productivity with Technology

WICAT
University Plaza, Suite 201
1160 South State Street
Orem, Utah 84057
Tel: 801-224-6400

Dr. Dustin H. Heuston, Chairman
Dr. C. Victor Bunderson, President

WICAT is a nonprofit institute to help education through technology. Its president, Victor Bunderson, was the principal designer of TICCIT software. Its chairman, Dustin Heuston, is an educator. Both are active in developing the educational potential of videodisks and microprocessors. WICAT works with a variety of organizations, including the National Science Foundation, the Defense Department, Ford, McGraw-Hill, and MCA/Discovision.

Heuston argues that education is a "mature" industry, a system which has reached the limits of the demands it can meet. As the demands continue to grow, the system's limits are surpassed. The only solution is to increase the system's productivity, which he feels can be done through the introduction of new, more productive technologies. He maintains that it is only a matter of time before the potential of videodisks and microprocessors inevitably change the classroom from the current passive situation -- in which he claims a learner is active only about 15 seconds an hour -- to one in which the learner is actively productive during most of the day.

Some References

Heuston: "Training, Technology, and the Educational Delivery System" (?1978?)

"The Promise and Inevitability of the Videodisc in Education" Submitted to NIE, 1977

Bunderson: "Instructional Strategies for Videodisc Courseware: The McGraw-Hill Disc", Journal of Educational Technology Systems, Vol. 8(3), 1979-80

Intelligent Videodisc: Motivations and Deterrents

Work of: Professor Lester F. Eastwood, Jr.
Associate Director
Center for Developmental Technology
Washington University
St. Louis, Missouri 63130
Tel: 314-889-5998

Lester Eastwood gives a thorough review of the motivations for and barriers to using intelligent videodisc. The motivations are well known -- by 1985 for an estimated cost of about $2,000 the videodisc could combine the interactive power of PLATO with the potential of film, grahics, audio and animation. Further, it is compatible with a decentralized educational system -- a single school could afford one.

But there are substantial barriers, many of which have blocked other technologies in the past. Unless supportive countermeasures are taken, many teachers are likely to fear intelligent videodisc, and few are apt to see personal rewards for being innovative in their current settings. Unions are likely to resist on the grounds that teaching by machine does not meet legally mandated supervision by certified instructors. As student populations decline, as they will for the coming years, and as budgets are squeezed, as seems likely for the future, administrators and school boards may not be eager to experiment with new approaches.

For videodisc software to become inexpensive, its development costs will have to be spread over large markets, which are not yet there. The hardware alone has been estimated to cost about $30.00 per student per year which is about the same as for a reading teacher ($32/student/year) or for films ($30/student/year). Training for teachers and other personnel is likely to be expensive. As the videodisc technology is new, there is as yet no research to demonstrate its value. Eastwood suggests that some of the above barriers could be met with creative federal intervention.

Reference

Lester F. Eastwood, Jr., "Motivations and Deterrents to Educational Use of 'Intelligent Videodisc' Systems", Journal of Educational Technology Systems, Vol. 7(4), 1978-9

Color PLATO Plus Videodisc

Work of: Howard B. Mark
Control Data Corporation
8120 Penn Avenue South, Suite 435
Minneapolis, Minnesota 55431
Tel: 612-853-8100

Control Data corporation has a new multicolor terminal for PLATO (their standard one is two-color only) and the terminal is being used experimentally to interact with the MCA and Thompson-CSF videodiscs. Mark feels that those who try it will probably like it.

Reference

Howard B. Mark, "PLATO Videodisc Interfacing", *Journal of Educational Technology Systems*, Vol. 8(3), 1979-80

Videodiscs in Nebraska: Learning Tumbling is Fun

Nebraska Videodisc Design/Production Group
KVON-TV
University of Nebraska
Lincoln, Nebraska 68501
Tel: 402-472-3611

Rod Daynes, Director

This spring in a Lincoln elementary school, four physical education teachers used videodiscs to help teach tumbling. They loved it. They could show children entire routines, skill vignettes, or frozen frames. They did this before and during practice. The teachers rated the program excellent instructionally and good to excellent technically.

Results of a similar field test with college-level Spanish courses were not as good. Some students found the program easy to use and helpful educationally. Others found it hard to use, but still saw a future for the medium.

This field test, by Robert Brown and Dianna Newman, is the second in what will be a series of investigations by the Nebraska videodisc design group. (The first report identified marketing strategies for videodisc in education.) The Nebraska group will host a conference October 8-10, 1980 entitled "A National Symposium on Videodisc Programming: Design, Production, and Premastering".

Associated with the group is the University of Nebraska Media Development Project for the Hearing Impaired, which also is investigating uses of intelligent videodiscs.

Reference

Robert D. Brown and Dianna L. Newman, "A Formative Field Test Evaluation of Tumbling and Spanish Videodiscs", Nebraska Videodisc Project Paper #2, July, 1980

Media Room: An Extraordinary Human/Computer Interface

Work of: Nicholas Negroponte
Professor of Computer Graphics
Architecture Machine Group
Massachusetts Institute of Technology
Cambridge, Mass. 02139
Tel: 617-253-1000

Of the people thinking about how to use systems that integrate video disks, television and computers, Nicholas Negroponte is one of the most innovative. He envisions combining these technologies to immerse a person in a "media room" where a wealth of information can be delivered in a myriad of ways. There would be movie-size television screens, projections and animation in color, spatially-synchronized sound, and touch-sensitive display devices. Users could control access to the computer by giving instructions or pointing, speaking, whispering, or using eye or body movements. This rather extraordinary collection of capabilities, if realized, would represent a "control and command" system more powerful than any in existence today. Negroponte and his associates advocate a system design with the ability to edit the 54,000 frames on a typical half hour video disk. Users could investigate some areas of the disk in detail and skip others, and could synthesize selected frames into new configurations. These procedures differ markedly from the old methods of sequentially presenting frames of information in pre-scripted movie style.

Negroponte has "elected to study concepts of human interfacing in their extreme, without consideration of today's [high] costs." He is convinced costs will decrease and that it is essential to initiate new pilot projects that will demonstrate the best innovative uses for the powerful, newly-emerging technologies. He justifies his argument by asserting that human time is the invaluable resource and the computational speed, bandwidth, and memory size are vast and essentially free. In assessing such systems, his measures are simple -- "Is it usable?", and "Does it feel good?".

If Negroponte's visionary approach does not seem to have immediate application to schools, neither has classroom practice been his main concern.* Nevertheless, his imaginative explorations of emerging media and their possibilities offer clues to educators on how to best use these media. Rather than repeating the limits of the book and film, Negroponte's vision suggests using all the learner's senses, giving learners unprecedented power to get the information they need.

Some References

Nicholas Negroponte, "Media Room" (unpublished report to the Office of Naval Research and Defense Advanced Research Projects Agency, December, 1978)

Nicholas Negroponte, "The Impact of Optical Videodisks on Filmmaking", (working paper, MIT)

Negroponte, "New Qualities of Computer Interaction" (proposal in progress, Data Space, to Cybernetics Technology, Office of DARPA)

Nicholas Negroponte, "The Metaphysics of Television" (paper submitted to IFIPS conference, 1979)

Negroponte et al., "Intelligent Videodisks and Their Application"

*His work has been supported largely by the Office of Naval Research and the Defense Advanced Research Projects Agency.

Innovation Outside the Schools: Big Bird via Small Computer

Work of: "Sesame Place"
100 Sesame Road
Langhorne, Pennsylvania 19047
Tel: 215-752-7070

Mrs. Joyce Hakansson, Computer Games Coordinator
Mr. Eric McMillan, Play Equipment Designer
Dr. Marilyn Rothenburg, Environmental and Content Planner

On July 30, 1980, one of the most innovative experiments in integrated educational technologies was opened to the public. "Sesame Place", an educational park and playground of the future near Philadelphia, combines elements of computers, microprocessors, videodisks, and televisions in imaginative learning games for children ages 3-13. If successful, which it is likely to be, it may become both a laboratory and at least one model for what schools can and should be doing with computer based systems. For this reason, the progress of Sesame Place should be monitored and evaluated by anyone concerned with policies in new uses of educational technologies.

Sesame Place is the first of a projected series of parks developed by the Children's Television Workshop and Busch Entertainment Corporation (a division of Anheuser-Busch). Through CTW, it has received some initial support from the Department of Education, although it is designed as a self-supporting commercial venture. It is a "total learning experience that blends wholesome physical activities, stimulating scientific experiments, and challenging computer games", according to its creators. Sesame Street characters such as Big Bird, Oscar the Grouch, and the Count are very much in evidence through the park. The entrance fee is a modest $3.95.

There are over 70 computers -- the largest collection of educational computers in the country -- featuring a myriad of "games". Based on new technologies of micrprocessing and videodisks, these are a world ahead of and apart from present "parlor and arcade" games. Probably one of the most significant advances is the fact that familiar Sesame Street characters appear on, guide, and occasionally are the subject of the games. This not only motivates children but also gives them a sense of security and familiarity.

Joyce Hakansson is the Sesame Place computer games coordinator and a former computer education coordinator at the University of California's Lawrence Hall of Science. The computer programs she supervises have been tested by some 700 students in schools in New York, Pennsylvania, and California, and the research findings were incorporated into the program designs. Sesame Place can serve as a laboratory for the schools, testing new ways of teaching concepts of logical thought, problem solving, and active participation. The games are also designed to promote computer literacy.

A sample of some of the games.

- Mup-O-Matic -- Guess the Muppet character emerging [illegible] patterns.
- Art Beams -- Create [illegible] design, then [illegible] squeeze, angle or flip it over.
- Lemonade -- Running a lemonade [illegible] makes money and what doesn't.
- Reflect -- Bouncing a light beam [illegible] makes a rosebud blossom or something [illegible] screen.
- Tune In -- [illegible] phrases.
- Paddle [illegible] -- [illegible] out the ball's trajectorie.

Sesame Place has vast implications for schooling. Among them:

- People in organizations outside the school system (even outside the academic community) have an advantage in designing innovative uses of educational technology to the extent they are not subject to the budgetary and time constraints imposed by most schools and universities.

- Ways should be found for schools to link up with Sesame Place — for example, to have some Sesame Place games coordinated with a school's curriculum. Otherwise many schools will probably remain unaware of Sesame Place or will ignore it, just as most have been unable to use the television program Sesame Street.

- The notion of strict age grading [illegible] Sesame Place [illegible] as absurd [illegible] the notion of scheduling during the hours of a day [illegible]. The level of difficulty of a game played by a child depends, as in real life, more on individual ability than on age.

- Special hardware not generally available [illegible] be developed for educational purposes [illegible]

- Costs are low enough at Sesame Place that [illegible] at a profit.

QUBE

QUBE
Warner Communications Co.
930 Kinnear Road
Columbus, Ohio 43212
Tel: 614-481-5342

Dr. Vivan Horner
Vice-President of Educational
and Children's Programming
(Prior director of The Electric Company)

Dr. Gerry D. Jordan
Director, Program Development
Education Division

Both Drs. Horner and Jordan are at
Warner MX Cable Communications
75 Rockefeller Plaza
New York, NY 10019

A lecturer for a TV program, [illegible] a chance to choose between one of five answers to a question. At home viewers push one of five buttons and [illegible] three [illegible] a computer allows the lecturer to announce, "Only 45% got that right." [illegible] explain more, which he does until later 90% [illegible] right.

QUBE [illegible]

[illegible]

[illegible]

allows viewers to push one of five buttons in response to questions and programming they did not generate or discuss. Some feel the polling so far has been only commercial or trivial.

Nonetheless, QUBE is important because by being commercially viable it is consolidating a new two-way technology which has potential for the future.

Reference

Gerry D [illegible] "Education QUBE - An Approach to Life Lo[illegible] Learning"

People Talking to People: BCTV

Work of: Gerald J. Richter
Executive Director
Berks Community Television
1112 Muhlenberg Street
Reading, Pa. 19602
Tel: 215-374-3065

Berks Community Television (BCTV) is an open forum for the community, using communications technologies to permit citizens to discuss issues and solve problems in an atmosphere of give and take.

Begun in 1975 by the New York University Alternate Media Center and the Graduate School of Public Administration, BCTV provided a closed circuit network by which senior citizens could communicate with one another about common concerns. Richter says research shows that senior citizens using the system feel better about themselves. Since 1975, BCTV has expanded to provide a variety of programs, including ones in which young and old discuss the generation gap, the school board gives reports, and [illegible] interview older people about their recollections.

Three things are key to BCTV's success. Fi[illegible]

[illegible]

[illegible]

BCTV Monitor [illegible]

"Talk Back to [illegible]"
Penthouse, March [illegible]

"CATV: Two-Way [illegible]"
by Clint Page, Nations Ci[illegible]

"Talk Back to Your TV", Oasis [illegible]

Student Produced Television

Work of: John LeBaron
Project Director for Planning and Development
Massachusetts Educational Television (MET)
Massachusetts Department of Education
54 Rindge Avenue Extension
Cambridge, Mass. 02140
Tel: 617-876-9800

A sixth grader is behind a television camera taping a fellow student who is interviewing the daughter of a woman who is feeding her family vegetarian meals in protest against the rising cost of meat. This all began when the sixth graders saw an article about the protest and decided to make a documentary about the issue. Breaking into task forces, they videotaped interviews with supermarket managers, the protesting woman, and a nutritionist. [illegible] the material publicized their effort [illegible] vision. All [illegible] problem solving.

John LeBaron [illegible] Making Television [illegible] published by Columbia Teachers College Press in the spring of 1981. [illegible]

Recognizing that using broadcasting as the mode of distribution for ITV forces teachers into a schedule not of their own choosing, LeBaron is now investigating non-broadcast distribution options for MEI under a grant from the Corporation for Public Broadcasting. They are exploring organizational structures through which videotapes, videodiscs, and cable may be used for marketing and distributing good instructional programs. The problems are considerable, but the benefits would be a more flexible way than precious broadcast time to get ITV to schools. [illegible] clearinghouse so that it would [illegible] the kind of [illegible] by the kids in [illegible]

[illegible]

[illegible]

[illegible] For Teachers of [illegible] College Press, spring 1981

[illegible] Implications of the New [illegible] Open Classroom [illegible] in Ideas and [illegible] Software/[illegible] Channels, Vol. II No. 6

Television Production for [illegible] Resources, January 19[illegible]4 [illegible]

[illegible]

Instructional Television in Schools: Three Studies

Corporation for Public Broadcasting (CPB)
c/o Peter J. Dirr
Projects Manager, Educational Analysis
1111 16th Street, N.W.
Washington, D.C. 20036
Tel: 202-293-6160

Peter Dirr has directed several significant [illegible] the extent — although not necessarily the effectiveness [illegible] the use of ITV (instructional television). [illegible] secondary schools is described in Uses of Television for Instruction, 19[illegible] Final Report of the School TV Utilization Study. It shows, for the first time, that as many as 15 million American pupils are receiving a regular portion of their instruction from ITV in 1976-77.

[illegible] Higher Education Utilization Study [illegible] indicate that in 1978-79, sixty percent of all institutions of higher education [illegible]

[illegible] Kobayashi [illegible]

[illegible]

[illegible]

It [illegible] would be a great cost-saver [illegible] that it does not save on costs as much as it [illegible] quality of the instruction in certain areas, and [illegible] possible to reach students who could otherwise not take advantage of the opportunity.

This realistic assessment in an industry which is now maturing -- at least compared to computers in education -- makes an interesting contribution in the debates about the future of educational technologies.

Some References

Higher Education Utilization Study, memo from Douglas F. Bodwell, Corporation for Public Broadcasting, November 28, 1979.

Uses of Televisions for Instruction [illegible] Report of School TV Utilization Stud[illegible], Peter J. Dirr and Ronald J. Pedone, Nat[illegible] Center for Education Statistics, U.S. Department of Health Education and Welfare, Washington, D.C., 1979

[illegible] Office of Educational Activities, Corporation for Public Broadcast[illegible], May 1, 1980

[illegible] Executive S[illegible]ary, Corporation for P[illegible] B[illegible]

[illegible] Co[illegible]ise Matthews [illegible], Corporation for Public Broadcasting, 19[illegible]