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AUTHOR	Druian, Greg
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ABSTRACT

This report discusses key problem areas in the use of computer technology in education and describes current educational practices that appear to address the needs of urban educators. The problem areas, which were identified by the Technological Study Group of the National Institute of Education's Urban Superintendents' Network, concern: (1) the provision of effective computer literacy programs; (2) linkages between technology and employment skills training; (3) the avoidance of obsolescence of computer hardware and software; and (4) the creation of networks, or connections, among different technological tools for instructional and/or administrative purposes. For each problem area, relevant issues are discussed and promising practices or projects are briefly described. Names and addresses of contact persons for some of the projects are provided. The report also considers key policy making areas for urban districts that intend to employ computer technology in education. Appended to the report are a directory of members of the Technology Study Group, a partially annotated bibliography of references and instructional materials, and a list of other information sources. (MJL)

RESOURCES FOR DECISION MAKERS

No.1

Promising Practices in Educational Technology: Policy Alternatives for Urban Educators.

by Greg Drulan
June, 1982

Helping Educators Make Effective and Efficient Use of Microcomputers in Today's Schools

Computer Technology Program
Judith Edwards Allen, Director

Northwest Regional Educational Laboratory
300 S.W. Sixth Avenue
Portland, Oregon 97204
Robert R. Rath, Executive Director

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Promising Practices in Educational Technology:
Policy Alternatives for Urban Educators

I. Problems

Urban educators today face problems like these:

1. declining enrollments and eroding tax bases
2. influx of students who do not speak English at all or who speak English very poorly
3. staff "burnout" and lack of motivation
4. large numbers of economically disadvantaged youth
5. pressures to graduate students with basic skills sufficient for successful entry into work force
6. need to do "more with less" at the administrative level

II. Technology as a Partial Solution

The "technological revolution" may offer a partial solution to problems like those listed above. The rapid increase in power, coupled with the decrease in cost, of microprocessors has brought about two significant developments: (1) far greater numbers of persons than ever before--students, teachers, administrators--have access to microcomputers; and (2) connections among microprocessor-based devices enable speedy transmission of large amounts of information over virtually any distance.

Because of these developments, it is now possible to do things like the following:

1. provide extensive individualized instruction
2. provide new motivation both for students and instructional staff
3. free up teachers so that they can spend more time with instruction
4. offer classroom experiences with software simulations that would otherwise be impossible or impractical
5. provide access to large amounts of information through online data bases
6. provide a meaningful level of computer literacy for all or nearly all kids

7. train young persons more effectively to perform complex logical and analytical tasks necessary for problem solving

8. provide flexible record-keeping, monitoring, computer-managed instruction

9. contribute to the preparation of young people for job increasingly dependent on technology.

In June of 1981, the Urban Superintendent's Network of the National Institute of Education established a Technology Study Group in response to a challenge by the Secretary of Education to take advantage of the contributions technology could make to education. The purpose of the study group is to explore what technology can and cannot do for education. Pilot activities, involving field testing of various applications of communications and computer technologies, are currently being established. Five school districts are participating in the study group: Boston, Cincinnati, Detroit, Houston and Salt Lake City (names of contact persons can be found in the resource section forming Part V of this paper.)

III. Issues Identified by Northwest Urban Superintendents

In attempting to implement technological enhancements to education, the following have been cited as key problem areas by northwest urban superintendents:

1. How to provide effective computer literacy programs

2. How to link technology with efforts to foster employability development

3. How to avoid the problem of obsolescence both of hardware and software

4. How to "network" or build connections among different technological tools such as micros and mini or mainframe computers, information utilities, videodisc systems for instructional and/or administrative purposes

Each of these four problems is expanded upon below.

COMPUTER LITERACY:

Description of Issue

The advent of microcomputers with substantial computing power at an affordable price has resulted in heavy pressures on schools to implement curricula in computer literacy. Basic computer literacy is felt to be a necessity for both working and living in coming years, and many experts claim that the skills gained while learning to use computers have application in many different fields.

The pressure to teach computer literacy has not been accompanied with general agreement as to what ought to be included in a computer literacy program. Available evidence, however, suggests three fairly distinct schools of thought about how computer literacy ought to be approached.

The first approach may be termed "awareness" and is characterized by activities in which students are taught about the computer. This approach stresses such topics as history of computing, applications of computing in different careers, types and components of computers and computing systems, and understanding what computers do.

Awareness approaches characterized most early attempts to teach computer literacy, and began to be developed before micros were as readily available as they are now. As a consequence these approaches do not feature a lot of hands-on involvement with computers.

A second approach, almost the reverse of awareness, may be identified, which we will name "specialization." This approach features intensive hands-on involvement with computers for significant periods of time. Within this approach, students are encouraged to develop substantial knowledge and facility with one or more programming languages, and to become adept at using computers to solve problems. Correspondingly little time is spent on teaching students about computers.

Somewhere in between lies a third approach which might be called "functional computer literacy." This approach features both hands-on experience with the computer as well as activities designed to teach about the computer. Particularly important among the latter are activities which help students think through and integrate their understnding of their hands-on experiences at the computer keyboard.

Approaches based on functional computer literacy do not seek to impart advanced knowledge of programming languages, but rather try to teach familiarity with a major language, usually BASIC. LOGO is another programming language that is increasingly being used in computer literacy courses. This approach also attempts to give experiences with computers to a wide range of students. While all three approaches may be used with students of nearly any age, a "functional" approach to computer literacy tends to be aimed at the "all purpose user" rather than to a prospective computer specialist.

Programs that emphasize the functional use of computers recognize that computers will play a primary role in tomorrow's world, but they also recognize that not everyone will need to be a computer specialist to succeed. Young persons prepared for tomorrow's world will need to be able to make informed decisions about computers as resources for problem solving. They will not, however, need to know how to solve every problem with a computer. Consequently, the functional approach to computer literacy emphasizes the student of computers, in addition to the hands-on experience with them.

The three approaches may be depicted on a graph. The vertical axis depicts the amount of emphasis on vicarious activities (learning about the computer), while the horizontal axis represents the amount of emphasis on hands-on activities. Figure 1 below illustrates the relationships among the three approaches.

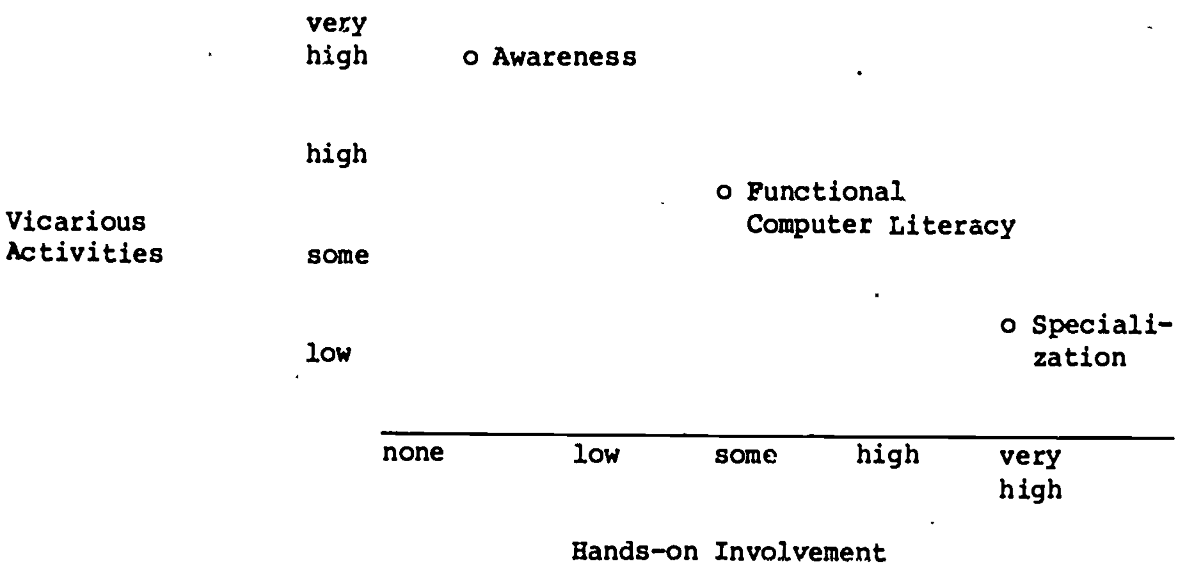

Figure 1: Relationships Among Approaches to Teaching Computer Literacy

Promising Practices

1. <u>Computeronics</u>

"Computeronics" is a nationally validated model for teaching computer literacy. Orginally developed in Florida for gifted students, it was field tested with sixth and seventh graders. Subsequent users have included urban schools, middle and junior high schools and gifted as well as undesignated students.

Training is available for teachers desiring to use "Computeronics," and is recommended. "Computeronics" is designed to be used with any brand of hardware; the recommended ratio of computers to students is 1-8. The model was disseminated in Florida using Title IV-C funds. Funds were used to purchase hardware and materials for students and teachers, as well as to cover costs of trainers.

Contact: Diane Johnson
Gifted Child Project
Leon County School Board
2757 West Pensacola
Tallahassee, Florida 32304

2. <u>My Students Use Computers</u>

"My Students Use Computers" is a NSF-funded effort involving HumRRO and the Montgomery County, Maryland, public schools. The aim of the project is to help staff and teachers infuse computer-related objectives and activities into science, social studies and math curricula for grades K-8. The curriculum is designed to support "universal computer literacy," that is, "skills and knowledge needed by all citizens to survive and thrive in a society that is dependent on technology for handling information and solving complex problems." A User's Guide describing this process for infusing computer literacy is scheduled for completion in 1982.

Contact: Beverly Hunter
HumRRO
300 North Washington Street
Alexandria, Virginia 22314

3. <u>Course Goals in Computer Education K-12</u>

Contains goals for use in planning and evaluating Elementary and Secondary school curricula in computer education (including such topics as computer literacy, computer science, computers and society, data processing and computer programming). Available from Commercial Educational Distributing Services, P.O. Box 8723, Portland, OR.

4. <u>Test Items for Educational Computing</u>

This is a set of student objectives, with three test items for each objective, prepared by NWREL for the Department of Defense Dependents Schools.

Contact: Dennis Bybee
Department of Defense
Office of Dependents Schools
2461 Eisenhower Avenue, Room 172
Alexandria, Virginia 22331

<u>TECHNOLOGY AND EMPLOYABILITY DEVELOPMENT:</u>

Description of Issue

The rise of technology has intensified the importance of career-related education and the importance of teaching basic educational skills (reading, writing and computation). Equally important is the issue of providing students with advanced skills, since technology will increasingly do away with jobs requiring few skills. As technology, especially computers, are involved with more and more parts of our economy, it follows that more and more jobs will require people who can interact in various ways with computers. An increasing number of people, regardless of the jobs they hold, will need skills like these:

o keyboard skills

- reading and interpreting technical manuals
- reading and selecting appropriate alternatives from choices on a screen

A typical job description of the future may include tasks like these:

- Monitor work flow of production systems
- Prepare input for and execute utility programs
- Provide interface with other departments about possible enhancements and determine computer program errors
- Provide technical liaison with users
- Evaluate and maintain new hardware/software[1]

Traditional public school programs may need to learn to work together in ways they have not done before. Computer literacy programs may need to relate to vocational programs, and basic skills programs in reading, writing and math may need to be overhauled to take into account needs of young persons to function in a technological society.

In addition, institutions concerned with learning may need to learn to coordinate in ways they have not done--or have only done in a piecemeal fashion. Public secondary schools, vocational training institutions, and community colleges should each be aware of what the other is doing.

The stake of private industry is particularly high and in many communities, schools and industries have collaborated productively:

1. High-tech industries have worked with school staff to define needed competencies for different occupations.
2. Students are placed on work experiences in the private sector.
3. Companies may donate hard- and/or software to a school district.
4. Schools may send instructional staff to seminars put on by company personnel.
5. Industries may operate instructional programs for youngsters using company equipment (hard- and software).

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1 Roy H. Forbes, "The Information Society: Will High School Graduates Be Ready," The School Administrator, April 1982, pp. 16-17.

Promising Practices

1. Control Data Corporation has invested substantially in the development of PLATO, a computer-based instructional system that has been used to teach basic skills in Baltimore and other large cities.

2. A model program in Electricity/Electronics has been established in the Portland Public Schools to meet the need for programs which accurately reflect industry needs and provide entry-level training as well as preparation for postsecondary instruction. Local businesses have been asked for their ideas on the electronics industry, its employment needs and how schools should be preparing students to find employment in Electricity/Electronics.

OBSOLESCENCE OF HARDWARE AND SOFTWARE:

Description of Issue

Many educators are wary of investing in microcomputer hard- and software because they believe prices will fall lower and computing power will grow higher. They are understandably concerned about getting the best and most useful equipment for their scarce dollars. Furthermore, the computing industry has sustained a dizzying rate of change with new products constantly coming on the market. Educators fear that what they buy today will be obsolete tomorrow.

One might compare the choice of a computer to the choice of a mate. While prices and kilobytes of RAM may not enter into the choice of a spouse, the serious spouse-hunter always harbors a nagging doubt that by waiting just a bit longer, he or she will find the perfect mate. In both cases, one generally does not make progress until one clarifies the purpose of the endeavor.

If a school district has used careful planning processes and determined, for example, that there is a need to teach the fundamentals of programming to middle school kids, district officials can then go and purchase equipment which lends itself to meeting that need. As long as the need is there, the equipment won't be obsolete. It may happen that new needs emerge which require new equipment. The issue is, however, not so much one of obsolescence as it is one of changing needs. In the example above, if it becomes no longer necessary to provide instruction in the fundamentals of programming, then the district may be stuck with machines it cannot use. Planning is the key to avoiding these kinds of problems to the extent that they can be avoided. It is important to realize that nothing will be gained by waiting for the optimum machine.

Best available guesses suggest that microcomputers have a useful life in the clasroom of from three to five years. Actual lifetimes will vary based on such things as:

- the amount of classroom use
- how frequently the machine is moved

- the extent to which the machine is reconfigured (new components are added

- the extent to which students handle various components

A microcomputer will not, of course, last forever and a school district should expect to have to replace computers it buys.

More of an issue perhaps than obsolescence is the question of the extent and ease with which a microcomputer system can be upgraded. Some systems make it a fairly routine matter to increase the memory capacity, to add on a different "operating system" (system governing the interaction of a microcomputer with disk drives, a monitor and other peripherals), or to add the capacity to use languages other than BASIC. With other systems, it may be difficult or impossible to do these things.

Naturally everyone would like a computing system which will do everything: kind of like the perfect mate. But until the computer which will do everything is developed, prospective users will have to carefully plan appropriate applications.

Hidden behind dense thickets of technical terminology, the fundamental trends in hardware and software development can actually be very easily described. First, microcomputers will be able to handle data more quickly than they can now do. Increased speed of computation and processing of data are the main benefits of the 16- and 32-bit microprocessors which are now appearing in microcomputers.

Second, micros will continue the trend of becoming smaller and more portable. Cordless computers shaped like thin notebooks will be on the market by 1985. The user will flip up the cover to reveal a display screen and a pressure sensitive keyboard.

Next, it will be increasingly easier to run software on different types of micros. Advances in "operating systems"--systems which govern the interaction of the parts of a microcomputer--will make microcomputers more flexible than they have thus far been. The result will be that the user will be able to run more software, regardless of the hardware. While the industry will perhaps never get to the point that any piece of software will run on any make of hardware, we should soon see a great deal more flexibility than now exists.

Management-based software will probably continue to increase in quality and availability.

Finally, it is uncertain whether educational courseware producers will make the required investment in software to assume the existence of quality software for all grade levels in all appropriate subjects. Two major factors seem to be at work here. First the issue of piracy and illegal copying laws has become such a large problem that producers are at best wary of committing large development costs to an enterprise with questionable profitability. Second there may be a backlash against the use of computers in schools. Evidence of such a backlash has surfaced recently in California with the emergence of a group lobbying against the educational use of microcomputers. In a time of tight economic conditions that threaten school budgets, school decision-makers may regard microcomputers as frill. More importantly they may regard the time and effort needed to properly plan and manage their incorporation into the instructional process as a "luxury," thereby practically guaranteeing failure.

In sum, the main trends are positive--computers will be able to do more in less space and will be more flexible. The private sector has been reluctant to make a major investment in the development of educational courseware, but that fact, by itself, will probably not reverse the trend in schools toward use of the micro.

Promising Practices

1. In Portland, Oregon, a steering committee was established to oversee long and short range planning for instructional computing in the public schools. In order to assist them, the Computers in Education Planning Committee commissioned an outside consultant (NWREL) to prepare a report with information about research on instructional computing. Surveys of students, parents and teachers were conducted and resources in and outside the school district were analyzed. Results were presented in the form of a report which also contained conclusions and recommendations.

2. In Houston, Texas, the schools were using timesharing systems as far back as 1972. But continuing problems such as high costs of phone line and malfunctions of equipment under heavy use prompted a decision to explore the use of microcomputers.

A task force was established which developed a position paper containing the following recommendations:

a. Hardware should meet certain standards (e.g., facilitate exchange of software, training requirements should not be excessive, maintenance should be available, documentation should be available).

b. Bid specifications should be developed for high volume purchase of hardware and software at the district level.

c. Staff development activities should be provided for administrators and teachers.

In order to receive a micro, individual schools are required to develop an implementation plan that outlines objectives, a plan for achieving objectives, software which will be used and location of the computer in the school. Additionally, 20 hours of training are received by the administrator, and at least two teachers must receive 16 hours of hands-on training. Training is provided by the central office, though teachers may pursue their own training if desired.

At present, planning for technology is the responsibility of an Associate Superintendent for Technology who works closely with staff of various departments in order to reduce "turf" problems. In this way, all technological instruction is coordinated in one place.

3. Philadelphia, Pennsylvania schools approached the problem of obsolescence through development of software to meet their own needs. By developing their own software and maintaining the capacity to modify it as their needs change, appropriateness of software is assured. However, now the quality of commercially available software has increased to the point where staff recommend purchasing, rather than developing software.

NETWORKING OF TECHNOLOGIES:

The most exotic solutions for urban educational problems may be found in the potential for link-ups between computers and other computers and communications devices. The development and use of such linkages is generally referred to as "networking" of technologies.

There are several levels of complexity which must be considered in identifying possible networks. At a fairly fundamental level computers in a single building or office can be wired to each other so that messages and information can be readily sent from one machine to another.

As the distances between computers increase, problems of interconnection become more complex. Obviously it becomes quite expensive to wire computers directly to one another. Ordinary telephone lines may be used, but transmission of information is comparatively slow and there is a danger of losing information. Data lines may also be used. These are like telephone lines but they are used only for transmission of information for computers, and consequently, the signal tends to be clearer and to operate more quickly. The problem with data lines is that while for instance, Portland and Atlanta may be connected by such a line, users in one of those sites may still experience problems since they are connected to the data line using a telephone line. The best answer is for the user to get his or her own data line to the outlet.

Satellite communications are an increasingly important way of sending and receiving information, particularly over great distances. For the use, the quality of the data will still depend on whether a data line or ordinary telephone line is used to link to the satellite transmitter and receiver.

All systems using telephone or data lines require either a terminal or a microcomputer configured as a terminal. To use a micro as a terminal the following components are needed:

- an acoustic modem
- an RS 232 interface
- software (e.g., Visiterm) which controls the use of the micro as a terminal

Finally, the rapidly developing technology associated with cable television promises yet another kind of linkage. Users within a cable TV service area can be wired to one another and to other computers using switching equipment and a central location to which subscribers are wired. TV cable is an excellent medium for transmitting and receiving signals, so that there is little danger of receiving garbled data. Computers could be built into or attached to TV sets to provide a means for interaction among users. While such a system has the obvious limitations of serving only subscribers within a given area, this limitation would not seem to affect use of this mode by a school district.

These various applications of networking technology may be pictured as in the figure below:

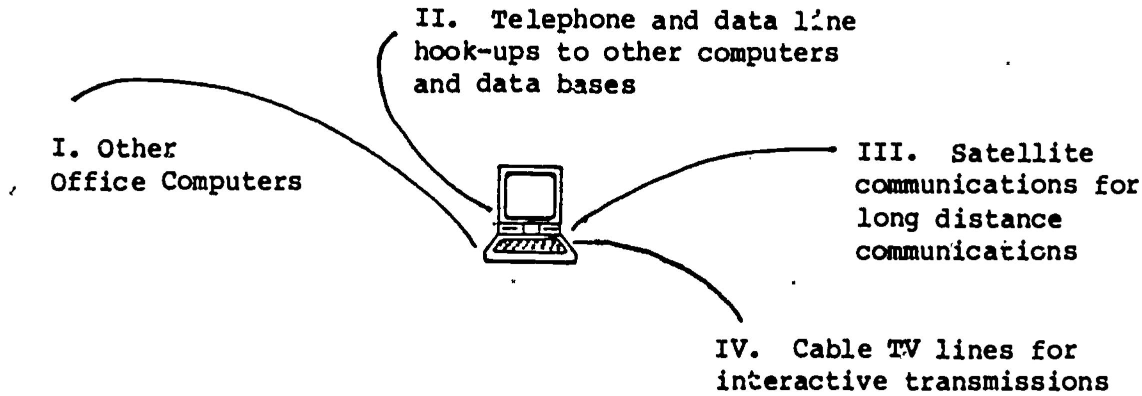

Figure 2: Some Applications of Networking Technology

While networking of technologies promises enormous benefits, the entire field is still so new that (a) we don't yet have a clear idea of what the potential benefits really are, and (b) there are numerous fundamental problems that need attention before the full benefits can be realized. The discussion below is intended to highlight the most pressing issues:

1. <u>Networking Implies Decentralization of Information</u>.

Typically computing functions in school districts have tended to be located in data processing departments. Data processing operators and supervisors have had control over large amounts of information. However, the possibility of building administrators having their own microcomputer makes for the possibility of reduced dependence on the data processing department for many kinds of information.

The extent to which large district computers and small personal computers are compatible may well determine how well information flows within the district. While principals may understandably be reluctant to do necessary data processing preparation both for their personal computers and for district computers, they need to understand what central office requirements are and their own role in meeting those requirements. Attention to whether information from microcomputers can easily be uploaded onto larger computers and vice versa can result in lessened conflict and better services for everyone.

2. What Kinds of Services and Information Can Networking Provide?

Three main kinds of services can be identified now. Message and conferencing services have to do with the ease and extent to which messages and information can be sent and received to facilitate decision-making. Electronic message centers can be used to direct messages to other network users. While some electronic messsage systems may be limited as to the length of documents that can be sent, other electronic mail systems allow the transmission of lengthy documents. Teleconferencing promises yet another kind of service, where parties in conference can have access to the same information via their computer terminals or TV screens.

Information services have to do with the kinds and amounts of information that are available online. Though there is not at present an extensive amount of educational information available online, the situation is changing and increasing amounts will soon be available. ERIC is available from several databases, and Bibliographic Retrieval Services (BRS) is marketing access to ERIC; to the School Practices Improvement File (SPIF), a collection of state and nationally validated educational programs; and to Resources in Computer Education (RICE), a database developed by the Computer Technology Program at the Northwest Regional Educational Laboratory. RICE, planned for availability in Fall, 1982, will contain information about educational software. Five files of information will be available:

- a Producer's File includes information about all commercial and noncommercial producers of computer-based instructional and administrative software
- a Software Packages File, containing descriptive and evaluative information about known products from producers
- a Computer Literacy File, which contains objectives and test items
- an Inventory File, which will have data on installations of hardware in schools, including information about numbers of student stations
- a Project Register File, describing R&D projects in K-12 computer applications

Finally, instructional services refer to the ways in which interconnections among computers and other communications devices can improve the instructional process.

- As mentioned earlier, access to large databases is one of the most important benefits of computer networking. As data bases are developed which contain information at appropriate grade levels, languages, reading levels, etc., students will be able to tap into information about nearly any subject area of interest. Isolation, limited resources and so forth, will be eliminated as causes of ignorance.

- Improvements in devices such as voice synthesizers, light pens and touch sensitive screens will make computer assisted instruction an indispensible tool in the education of handicapped persons. Physically disabled kids will be able to use the screen to work on kinds of problems they can't work on now.

- Instruction in the home will become more feasible for persons who are home-bound. Interactive TV promises great advances in this area, since the student via the interaction mode can allow the student to receive immediate feedback. Equipment can even be set up to allow responses to specific questions a student might have.

- Finally, instruction via videodisc linked to a microcomputer offers a truly flexible way to provide a variety of training experiences. The microcomputer can be linked to any piece of equipment upon which the student wants to learn to perform an operation. The operation is shown on the videodisc player, then the student tries it out. Any errors are registered on the computer and explained to the student. If needed, the videodisc can simply repeat the operation; also the computer can instruct the videodisc player to branch to a simpler or more complex procedure based on the student's response.

Promising Practices

1. As one of the sites participating in the Technology Study Group, Cincinnati is planning to examine the effects of full use of technology in schools. In Cincinnati, planning is underway to open such a school at the elementary level next fall. School staff are working with hardware manufacturers such as Texas Instruments and IBM and with commercial publishers such as Scott-Foresman to plan optional configuration, staff organization and curriculum organization in such a full-use environment. Present plans call for a central resource area with a large number of micros, complemented by a smaller lab in the Title I area. It is anticipated that there will be one micro for every two teachers in the school.

2. The School Practices Information Network (SPIN) has been established by the Education Service Group of Bibliographic Retrieval Services, an information utility. SPIN is a mechanism for sharing information about educational practices. Network members are linked through terminals or microcomputers and nationwide telecommunications channels. Linkages among members are accomplished using electronic mail and an online electronic newsletter available to all members. There is also an online profile of all members, who may use the system to request and exchange information and assistance. SPIN members also have access to the School Practices Informtion File (SPIF), a database on promising practices. Information about membership (which is free) may be obtained from:

School Practices Information Network
BRS/Education Service Group
1200 Route 7
Latham, New York 12110

IV. Policy Issues

The discussion below is aimed at identifying key areas in which policy decisions may need to be made if a district is considering the use of technology for either administrative or instructional purposes, or both. Certain overriding policy questions may be identified:

1. Should technology/computer use be promoted as a matter of district policy?

2. Should the nature of use and curriculum be specified on a district basis or left to individual schools/teachers/ departments?

3. Should technology/computer use be regarded as a requirement for all students, some students, or as an optional opportunity?

4. Should all administrators be "technologically literate"? All teachers? All board members?

While the purpose of this paper is not to promote specific answers to these questions, the discussion below assumes generally positive answers to questions 1 and 4 above, as well as a generally coordinated approach targeted on most students (vis-a-vis questions 2 and 3).

Policy alternatives suggested below are derived from interviews with school staff responsible for supplementing technology programs, reviews of literature, and accumulated experience.

1. Funding

Urban districts tend to use varied funding sources, including district funds and categorical funds, such as Title I and state compensatory education funds. A problem that has emerged with categorical funds is that they may be used only to serve certain students, and consequently they inadvertently contribute to the "differentiated access" problem (see below). With the advent of block granting, these problems are likely to diminish.

Costs which purchasers should be aware of include fixed and continuing costs. Fixed costs include:

a. Purchase costs

b. Installation costs

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1 Some of the materials in this section were prepared pursuant to a grant from the Information Dissemination in Science Federation Division of the National Science Foundation to the Minnesota Educatonal Computing Consortium in 1980.

c. Site preparation costs

- space preparation
- furniture

Continuing costs may involve:

a. Personnel

- Salary
- Training

b. Maintenance

c. Software

- Purchase
- Development

d. Supplies

- Tapes/disks
- Paper/Ribbons

e. Literature

- Manuals
- Texts
- Periodicals

f. Travel

- Conferences
- User groups

2. District Support

Successful introduction of microcomputers in a district seems to be associated with well-planned district support. Many districts offer supports such as the following:

a. Maintenance of a collection of software used in the district as well as at least one of each kind of hardware system. Such a collection enables teachers to try out various options before installing them in the classroom.

b. Evaluations of hard- and software. Practical information about how--and whether to--use courseware can save teachers substantial amounts of time and can contribute to efficient use of available courseware.

c. Support for user's groups.

d. Publication of newsletters. Newsletters can be of value in letting staff in different schools know of new developments and applications, as well as being a good dissemination vehicle for such things as new evaluations, announcements of courseware, etc.

e. Inservice and staff development. One district requires staff development both for the building administrator in the building where a micro will be placed as well as training for the teachers who will be using the equipment. Inservice credit may not always be possible, but is desirable.

f. Duplication of software and materials where permitted.

g. Central purchasing. Central purchasing arrangements can result in significant cost reductions.

In some states (e.g., Pennsylvania, Minnesota), significant support is available at the state level. District support should take this into account. In states (e.g., Texas) where there is little state support, a district (e.g., Houston) must provide all support.

3. Centralization v. Decentralization

Whether and to what extent a district centralizes the microcomputing function depends to a great extent on the organization of the district. In some districts, centralization is very strict: purchase of hard- and software may only be made in accordance with explicit guidelines and used for certain purposes. Usually a centralized approach implies a very close relationship between district curriculum goals and computer usage. Within a more decentralized approach, micros are used to meet different kinds of needs within a building or classroom and staff may be encouraged to use imagination and creativity in using micros.

The extent of centralization is a function of how closely computers are tied in with the curriculum. Listed below are sample uses that imply greater district coordination, followed by uses implying less:

Uses implying more coordination:

- o Drill and practice on district minimum competencies
- o Tutorial in BASIC to meet district computer literacy objective
- o Simulations in science course that is graduation requirement

Uses implying less coordination:

- o Drill and practice for optional activity/elective
- o Use of computer in one building only
- o Use of computer for special purpose

One district (Cincinnati) blends the advantages of centralization with those of decentralization by having both a central policy governing kinds of purchases and recommended uses, and a policy of accepting proposals from individual teachers or principals for purchases that go outside central guidelines.

4. Selecting Hardware and Software (Courseware)

The selection of hardware and software (or the decision to engage in inhouse development) depends on the planned use for the hardware and software.

The chart below depicts the implications of some common uses upon two system configurations, a minimal and a "full" one.

MINIMAL SYSTEM:

- 16K RAM
- Cassette or single disk
- Video Display

FULL SYSTEM:

- 48K+ RAM
- Dual Diskette Storage
- Video & Printer
- Multiple Input Modes

SIMULATIONS

PROBLEM SOLVING

INSTRUCTIONAL GAMES

INTRODUCTORY PROGRAMMING

ADVANCED PROGRAMMING (COMPUTER SCIENCE)

CALCULATIONS

DRILL

MATERIALS GENERATION

INFORMATION RETRIEVAL

STUDENT ANALYSIS OF DATA

TUTOR

INSTRUCTIONAL MANAGEMENT

ADMINISTRATIVE APPLICATIONS

Figure 3: Applications of Minimal vs. Full Systems

Other factors to consider are:

Ease of use

- Documentation
- Technical knowledge required

Technical support

- Servicing
- Training
- On-call assistance
- Programming
- Updating operating systems
- File maintenance
- Software development, installation

Dependability

- Sturdiness
- Reliability

Expandability

- Memory
- Peripherals

Input/Output Modes (Flexibility)

Software

- Availability
- Quality

It is also important to consider environmental factors, such as space, air circulation, static electricity, power, cabling, lighting, furniture, noise, accessibility, and security.

In a similar way, decisions about what software to purchase also depend on planned uses, as depicted in the illustration below:

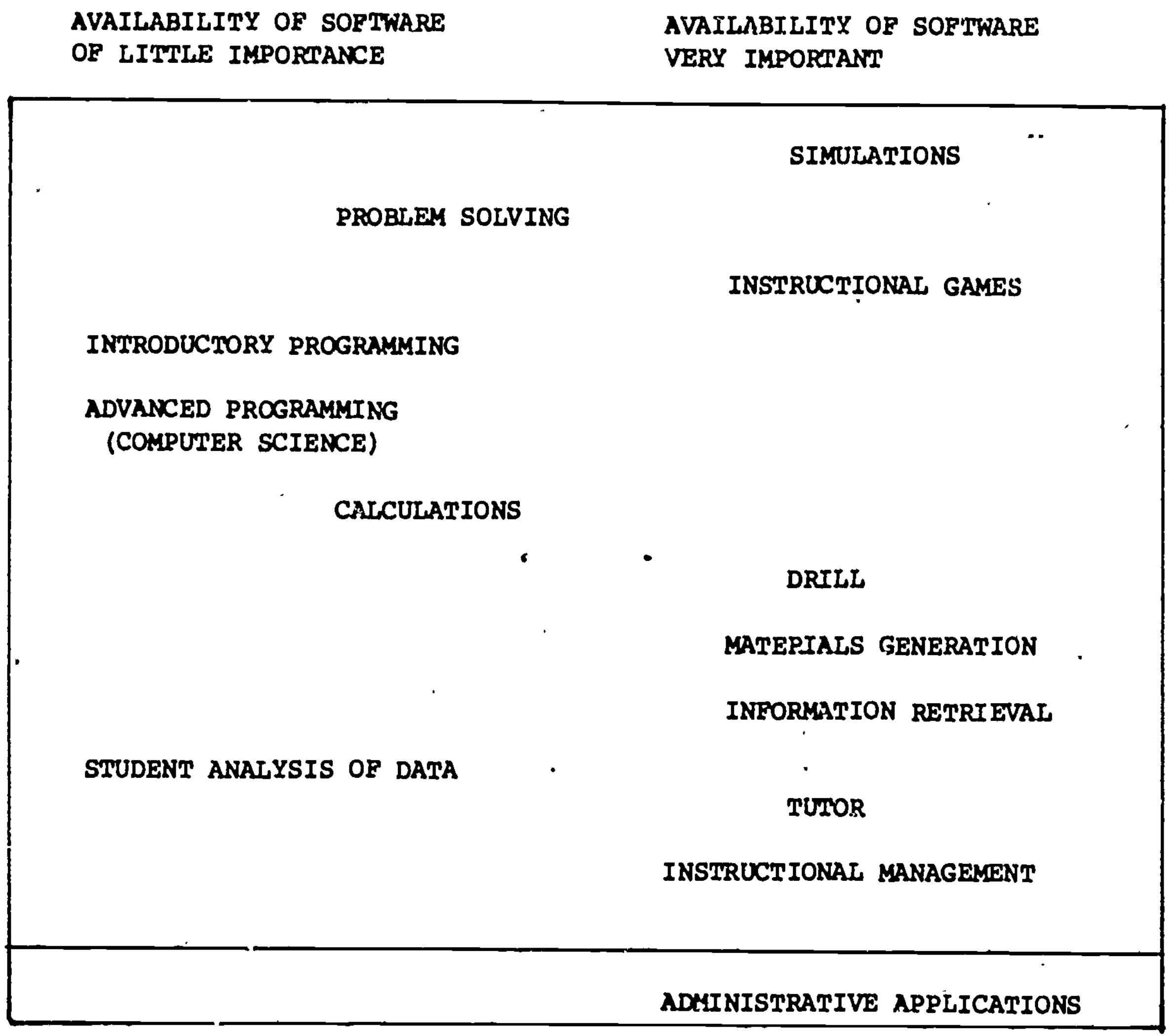

Figure 4: Importance of Software Availability for Various Applications

Criteria used for selection of software frequently include the following:

a. Existence of outside reviews

b. Identification of objectives

c. Relation of Objectives to existing curriculum

d. Compatibility with existing hardware

e. Documentation and other support materials for teachers/students

5. Differentiated access

Many districts find that some students have more access to technology than others. Specifically, secondary students have more access than elementary students, boys more than girls, math students more than nonmath, gifted more than remedial, privileged more than disadvantaged. Reducing the likelihood of this takes planning (see below).

6. Planning

Successful introduction of technology requires good planning. In one district, a steering committee was created, along with a more task-oriented group which reported to the steering committee.

A steering committee might be made up of:

a. a central office administrator--stand-in for the superintendent

b. curriculum administrator

c. finance administrator

d. data processing supervisor

e. building administrator

f. teacher

g. media specialist/librarian

Tasks that the steering committee might establish are:

a. setting forth a timeline

b. setting district goals

c. developing alternative plans of action

d. gathering information on alternatives

e. selecting a plan

f. developing a system for monitoring progress

Some of these tasks may be appropriately carried out by independent outside consultants, and some involve decisions that need to be made by the school board.

7. Location

The location of a micro in a school can be in a classroom, a resource center or mobile (moving among classroom or even buildings). The location should support the instructional use for the micro. For instance, micros may be appropriately used in a classroom when there is a need for quick reinforcement of a concept that is being learned. Micros in a resource center are appropriate for self-instructional lessons and various problem solving tasks.

8. Turf

The issue of "turf" can surface both in instructional and administrative uses of computers and technology. At the instructional level, various curricular areas will have their own uses and none, understandably, wishes to be dominated by the others.

The typical situation is that the math department takes the lead in securing a computer in a building. If another department wants a micro, it must operate independently, and the situation soon develops when six or seven groups all have different micros they are using for their own purposes. While short-term goals of individual classes may be met under these circumstances, it is usually difficult to accomplish much else.

In Houston, the establishment of an Associate Superintendent for Technology has diminished problems of turf. This person meets regularly with department personnel to plan computer applications and solve problems.

At the administrative level (see below), principals are quickly becoming aware of the micro's ability to provide important information on matters such as daily attendance, thus relieving a burden on district data processing staff. What may be a danger is that principals may be unwilling to provide data for DP, thinking (erroneously) that their personal micro can meet the entire district's data processing needs.

9. Administrative Uses

Houston and Cincinnati have both had experience linking computer software to existing minimum competency programs in various subjects. By generating reports that showed student performance measured against a national criterion, staff in Houston were able both to generate support for the use of computers and to generate involvement of the community in educational activities.

Administrative users of micros with district-wide implications should involve the central DP office, and the machine interface needs to be planned.

10. Community Relations

Several things can be done with micros to improve community relations: reports on individual student performance can readily be generated and mailed to parents; arrangements with computer companies can be made where students receive on-site/field experience learning about computer careers or job skills; staff development sessions can be arranged using personnel from technology-related industries as instructors; evening classes using computers for parents and other community persons can be arranged.

V. Resources

National Institute of Education Urban Superintendent's Network: Technology Study Group

Key Person:

BOSTON PUBLIC SCHOOLS

Dr. James Breeden
Senior Officer
Office of Planning & Policy
26 Court Street
Boston, MA 02108
617/726-6310, 6319, 6344

CINCINNATI PUBLIC SCHOOLS

John H. Grate
Director, Planning & Development Branch
231 E. Ninth Street
Cincinnati, OH 45202
513/369-4870

DETROIT PUBLIC SCHOOLS

Stuart Rankin
Assistant Superintendent
Research Planning & Evaluation
5056 Woodward Avenue
Detroit, MI 48202
313/494-1100

HOUSTON INDEPENDENT SCHOOL DISTRICT

Patricia Sturdivant
Assoc. Superintendent/Technology
3830 Richmond Avenue
Houston, TX 77027
713/625-5581

SALT LAKE CITY SCHOOL DISTRICT

Jack Hart, Principal
Glendale Intermediate School
1430 Andrew Avenue
Salt Lake City, UT 84104
801/972-4517

Superintendent

BOSTON PUBLIC SCHOOLS

Dr. Robert Spillane
Superintendent
26 Court Street
Boston, MA 02108
617/726-6364

CINCINNATI PUBLIC SCHOOLS

Dr. James N. Jacobs
Superintendent
230 E. Ninth Street
Cincinnati, OH 45202
513/369-4700

DETROIT PUBLIC SCHOOLS

Mr. Arthur Jefferson
Superintendent
5056 Woodward Avenue
Detroit, MI 48202
313/494-1000

HOUSTON INDEPENDENT SCHOOL DISTRICT

Mr. Billy J. Reagan
General Superintendent
3830 Richmond Avenue
Houston, TX 77027
715/623-5011

SALT LAKE CITY SCHOOL DISTRICT

Mr. Don Thomas
Superintendent
440 East First South
Salt Lake City, UT 85111
801/322-1471

NATIONAL INSTITUTE OF EDUCATION

Candace Sullivan, Team Leader
Dissemination and Improvement of Practice Program
1200-19th Street N.W./Room 606-C, Mail Stop 26-A
Washington, D.C. 20208   202/254-5310

Books/General Background

Hunter, Beverly, et. al. Learning Alternatives in U.S. Education: Where Students and Computers Meet. Englewood Cliffs, New Jersey: Educational Technology Publications, 1975.

Jennings, Lane and Sally Cornish, eds., "Education and the Future." Selected articles from The Futurist and the World Future Society Bulletin. Washington, D.C.: World Future Society, 1980.

Joiner, Lee Marvin, et. al., Microcomputers in Education: A Nontechnical Guide to Instructional and School Management Approaches. Learning Publications, Inc., P.O. Box 1326, Holmes Beach, Florida 33509.

Kelsh, Bruce and John Lindelew, "Microcomputers in Schools: Promise and Practice." OSSC Bulletin, Eugene, Oregon: University of Oregon College of Education, April 1972.

Moursund, David. School Administrator's Introduction to the Instructional Use of Computers. Eugene, Oregon: International Council for Computers in Education, 1980, 48 pp. $2.50.

This volume focuses on practical considerations of using the computer as an aid to instruction. It is available from the Department of Computer and Information Science, University of Oregon, Eugene, Oregon 97403. Also available are Introduction to Computers in Education for Elementary and Middle School Teachers ($7.00), Teacher's Guide to Computers in the Elementary School ($2.50), and Precollege Computer Literacy: A Personal Computing Approach ($1.50).

Papert, Seymour. Mindstorms: Children, Computers and Powerful Ideas. Basic Books, 1980.

Written by the leader of the team which created LOGO, a computer language originally developed for children. This book presents a vision of what might be possible using computers as a learning resource.

Scheingold, Karen, et. al., "Study of Issues Related to Implementation of Computer Technology in Schools." Final Report to NIE. Bank Street College of Education, July 1981.

Taylor, Robert P., ed. The Computer in the School: Tutor, Tool, Tutee. New York: Teachers College 1980. 260 pp., bibliography, index.

This collection of essays is aimed at introducing the work of five prioneers in the use of computers in education. Alfred Bork, Thomas Dwyer, Arthur Luehrmann, Seymour Papert and Patrick Suppes are each profiled, and the main outlines of their work is shown in essays each has written.

Journals/Indexes

The journals listed below focus on educational applications and contain pertinent articles, reviews/evaluations of courseware or both.

Microcomputer Index. Subject index covering more than 1250 microcomputer magazine articles with abstracts. Appears quarterly and is available online using a telephone and terminal.

The Computing Teacher. International Council for Computers in Education, Department of Computer and Information Science, University of Oregon, Eugene, Oregon 97403. Published nine times annually. Subscription: $14.50.

Videodisc/Videotex. Microform Review, Inc., 520 Riverside Avenue, P.O. Box 405, Sungatuck Station, Westport, Connecticut 06880. Published quarterly. Subscription: $52.00.

AEDS Monitor. 1201 Sixteenth Street, N.W., Washington, D.C. 20036. Published quarterly. Subscription: $15.00.

Courseware Magazine. 4919 N. Millbrook, #222, Fresno, California 93726. Contains cassette tape with courseware programs for Apple, Pet or TRS 80. Published 5 times annually. Subscription: $65.00.

Electronic Learning: The Magazine for Educators of the 80's. Scholastic, Inc., 902 Sylvan Avenue, Englewood Cliffs, New Jersey 07632. Published 8 times annually. Subscription: $19.00.

Microcomputers in Education. Queue, Inc., 5 Chapel Hill Drive, Fairfield, Connecticut 06432. Published monthly. Subscription: $28.00.

Classroom Computer News. P.O. Box 266, Cambridge, Massachusetts 02138. Published bimonthly. Subscription: $12.00.

Educators Micro-Digest and Software Exchange. Educorp 21 Ltd., P.O. Box 162, Madison, Wisconsin 53791. Published monthly. Computer software development for vocational educators. Subscription: $63.00.

Electronic Education. Electronic Communications, Inc., Suite 220, 1311 Executive Center Drive, Tallahassee, Florida 32301. Publisned ten times annually. Subscription: $10.00.

Journal of Courseware Review. Apple Educational Foundation, 20525 Mariani, Cupertino, California 95014. Published quarterly. $5.95 per issue.

School Microware Reviews. Dresden Associates, P.O. Box 246, Dresden, Maine 04342. Published biannually. Subscription: $20.00 per issue. This journal is devoted exclusively to courseware reviews and includes an index to reviews in other publications as well as a description of the evaluation process.

Instructional Materials

Curriculum Materials

Horn, Carin E. and James L. Poirot. Computer Literacy: Problem-Solving with Computers. Austin, Texas: Sterling Swift Publishing Co., 1981, 304 pp. $13.95 + instructional manual $7.95 (free on adoption.)

Appropriate for use with junior high to adult age groups. Intended for audiences needing introductory material on computers. Text supported with ample visual material.

Rice, Jean and Sandy O'Connor. Computers are Fun. Minneapolis: T.S. Denison and Company, Inc., 1981, 62 pp. $3.95d + Teacher's Guide and Activity Book, 92 pp. $12.00.

These materials are designed to introduce 4-9 year olds to beginning computer concepts. The Teacher's Guide contains unit outlines, chapter aids and masters for duplicating. Available from T.S. Denison and Company, Inc., 9601 Newton Avenue South, Minneapolis, Minnesota 55431.

Rice, Jean. My Friend the Computer. Minneapolis: T.S. Denison and Company, Inc., 1981 (revised). 96 pp. $4.95 + Teacher's Guide and Activity Book, 61 pp. + 42 duplicating masters. $15.00.

Available from the same publisher as Computers are Fun. These materials are intended for use with grades 4-7. The content focuses on an introduction to computers and their uses. The Teacher's Guide contains pre- and post-tests with answer keys and duplicating masters.

"Computeronics." Developed by Gifted Child Project, ESEA Title IV-C. 2757 West Pensacola Street, Tallahassee, Florida 32304.

This is a nationally validated (NDN) project designed for high achieving students in grades 6-7, which has also been used with grades 5-8. It consists of a 35-40 hour course in programming, problem solving and computer literacy (see "Computer Literacy--Promising Practices" section for further information).

Rogers, Jean B. An Introduction to Computers and Computing. Eugene, Oregon: International Council for Computer Education, 1981. 48 pp. $2.50.

This booklet provides an outline and materials for a course in computer science at the secondary school level.

My Students Use Computers. Human Resources Research Organization (HumRRO) and Montgomery County, Maryland, Public Schools, Beverly Hunter, Principal Investigator, 1981.

This draft product is intended as a guide for educators, parents and others. Its purpose is to help plan and implement computer literacy at the K-8 level. Although still in test stages, the material contains sample curriculum plans, lessons and activities coordinated across all grade levels.

Sample Objectives

The following sources have developed objectives for computer literacy programs.

Course Goals in Computer Education K-12. Portland, Oregon: Commercial Educational Distributing Services, 1979.

A comprehensive set of goals which may be used in planning and evaluating a range of computer education curricula.

"Cupertino School District Developers Computer Literacy Curriculum," The Computing Teacher, 9 (1), September 1981, pp. 27-34.

Information about the curriculum is available from the Cupertino Union School District, 10301 Vista Drive, Cupertino, California 95014. The goals for this curriculum appear in the article listed above.

"Developing Computer Literacy in K-12 Education," The Computing Teacher, 9(3), November 1981, pp. 43-48.

This article presents the results of the efforts of a group of teachers, supervisors and administrators who met to develop a coordinated approach to teaching computer literacy. Objectives are listed in the article; further information is available from the Board of Cooperative Educational Services, Third Supervisory District, Suffolk County, New York.

Some Sources of Further Information

Microcomputer Software Information for Teachers (MicroSIFT) (K-12)
Northwest Regional Educational Laboratory
300 S.W. Sixth Avenue
Portland, Oregon 97204
(503) 248-6800

Association for Educational Data Systems (AEDS)
1201-16th Street N.W.
Washington, D.C. 20036
(202) 833-4100

Association for Development of Computer-Based Instructional Systems (ADCIS)
Computer Center
Western Washington University
Bellingham, Washington 98225
(206) 676-2860

Association of Computer Users (ACU)
P.O. Box 9003
Boulder, Colorado 80301
(303) 499-1722

CONDUIT
P.O. Box 388
University of Iowa
Iowa City, Iowa 52244
(319) 353-5789

International Council for Computers in Education (ICCE)
Department of Computer and Information Science
University of Oregon
Eugene, Oregon 97403
(503) 686-4408

Minnesota Educational Computing Consortium (MECC)
2520 Broadway Drive
St. Paul, Minnesota 55113
(612) 378-1122

Technical Education Research Centers (TERC)
Computer Resource Center
8 Eliot Street
Cambridge, Massachusetts 02138
(617) 547-3899

Computer Using Educators (CUE)
Independence High School--Computer Center
1776 Education Park Drive
San Jose, California 95133