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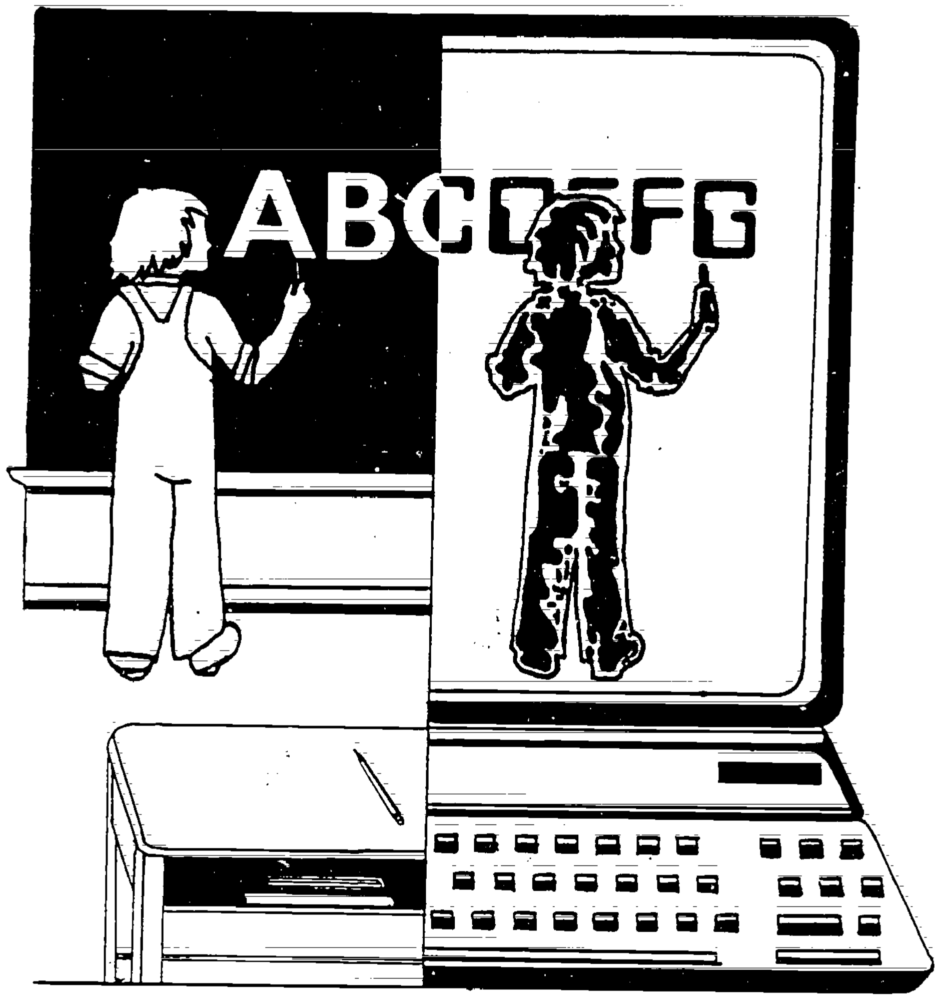
ABSTRACT

This notebook was prepared to provide resources for educators interested in using computers to increase opportunities for all students. The notebook contains specially prepared materials and selected newspaper and journal articles. The first section reviews the issues related to computer equity (equal access, tracking through different instructional uses of the computer, and bias and stereotypes in software). The second section presents an overall context for planning equitable education programs in an information society, exploring the economic context for education, the societal context for educational change, school improvement through technology use, and change strategies. The third section contains information about computer uses to help educational administrators and teachers to keep up with an improving technology. The fourth section contains materials related to software evaluation, including several evaluation instruments, one of them an equity evaluation instrument. The final section provides an overview of the participation of women and minorities in computer-related employment areas and educational programs. It also presents projected occupational growth trends. Appendices provide sources of software reviews, a list of software clearinghouses, sources for additional information, a listing of educational publications about microcomputers, and a glossary of key computer terms. (CMG)



THE COMPUTER EXPLOSION

Implications for Educational Equity

THE MID-ATLANTIC CENTERS FOR RACE AND SEX EQUITY
School of Education
The American University

U.S. DEPARTMENT OF EDUCATION

RESOURCE NOTEBOOK

THE COMPUTER EXPLOSION:

IMPLICATIONS FOR EDUCATIONAL EQUITY

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INTRODUCTION

Integrating computers into the school curriculum can expand educational opportunities for students. However, without particular attention to equity issues the computer revolution has the potential to widen the gap between advantaged and disadvantaged, male and female, majority and minority students. It is our goal to prevent this from occurring. This notebook is designed to provide resources to educators interested in using computers to increase opportunities for all students.

The first section, "Computer Equity," presents an overview of equity issues as they relate to computer education as well as a short summary of those issues. Several articles discuss various aspects of the computer equity problem including equal access of the advantaged and disadvantaged, males and females and majority and minority students; tracking through different instructional uses of the computer; and exposure to bias, stereotyping and negative values present in educational software.

The second section, "Seeking Educational Equity In An Information Society" presents an overall context for planning equitable educational programs in an information society. These materials explore the following issues: an economic context for education; the societal context for educational change; achieving school improvement through the use of technology; and developing a strategic plan for change.

In the third section, "Instructional Uses of the Computer," several articles are included for both administrators and teachers, including a chart outlining instructional uses of the computer; a review of the research on the effectiveness of computer-assisted instruction; an article discussing how to use data banks to assist educational administration, teaching and learning; a short discussion of how to manage a classroom with 25 students and one computer, and suggestions for effective uses of the microcomputer for central office administration.

The fourth section, "Evaluating Software," includes an article that outlines the central issues in evaluating educational software as well as several instruments for evaluating the quality of the software. Additionally, an equity evaluation instrument has been developed for use with other instruments that often fail to adequately address equity issues.

The fifth section, "Statistical Overview: A Look at the Labor Force," includes several tables that present trends in education and labor. These tables provide essential information for educational planners.

Finally, there are several appendixes which provide references for additional information and resources. These appendixes include sources of software reviews, a list of software clearinghouses, sources for additional information, educational publications about microcomputers and a glossary of key computer terms.

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CHAPTER

A. Computer Equity

This chapter reviews the issues related to computer equity. It includes the following resources:

COMPUTER EQUITY*

Why Emphasize Computer Equity?

As the computer becomes the universal medium through which we conduct most of our professional and personal activities, computer literacy will become a basic skill. At a recent national conference, a U.S. Department of Labor official predicted that by 1985, 80% of all jobs will require some knowledge of computers. Computer-related occupations are expected to be the most rapidly growing occupational group in the economy over the next decade.

In the midst of budgetary concerns and increased public demand for services, educational leaders must identify the kind of learning that will be demanded by the technology of the 21st century. As the nation moves from an industrial to an informational society, schools must accelerate the process of preparing all children to live in a new economic world. It is becoming increasingly obvious that computer literacy will be a central part of that preparation. It is important that all students learn the technical skills they will need as productive individuals. With computer education a growing part of the educational process, computer equity becomes a growing concern.

What Do We Mean by Computer Equity?

As computer literacy becomes a basic skill, equal access to and participation of all students in computer instruction becomes essential. This is the concept we are labeling computer equity. Equity efforts require awareness, action, and the flexibility to employ different approaches to meet diverse needs. Computer equity requires close examinination and re-examination of:

- how students gain access to computer literacy and computer-assisted instruction
- whether decisions about the appropriate educational software are influenced by the race or sex of the student
- whether software subtly communicates race, sex, or learning style biases

Computer Access

Students who do not gain early access to computers and quality educational software will have their potential severely limited. Middle and upper class parents who acquire home computers are painfully learning that the older one gets, the more difficult it is to understand and use computer technology. These parents see their three-year-olds master on the home computer what they at 33 have difficulty mastering.

*Developed by Sheryl Denbo, Director, Mid-Atlantic Center for Race Equity.

Common use of the computer in the public and private sectors means that we have the capacity to access and utilize large data banks of information. We have at our fingertips information which formerly required an enormous amount of time, energy, money and talent to retrieve. With this kind of capacity, individuals in every discipline will be able to make enormous breakthroughs.

It is likely that children who gain access to the computer at increasingly younger ages will be able to make breakthroughs that were considered impossible at any age. It becomes painfully clear how great the difference will be between children who have been exposed to the computer early and children who have not.

At least in the short term the disparity between the advantaged and the disadvantaged has the potential to become severely exaggerated. As middle class families acquire home computers and as prosperous school districts rapidly integrate computers into the curriculum, the disadvantaged families and poor school districts may be left behind. Until the technology becomes widely affordable, the children of the poor may suffer permanent disadvantage.

Once computers are in the schools a major concern becomes who gets to use them. In schools with a limited number of microcomputers, how will students be selected for computer time? Will teachers or students themselves consider computer time more or less important for certain groups of students based on level of academic achievement, sex, race, ethnic group, learning disability or socioeconomic class?

Computers, traditionally viewed as "number crunchers," may be characterized by some, along with mathematics, as a "male domain." Studies of elementary school students reveal sex-related attitudes about mathematics aptitudes from as early as third grade — with both sexes considering mathematics to be a male subject. Sex-stereotyping by both boys and girls seems to adversely affect the mathematical achievement of girls in high schools. Feelings of anxiety experienced by females when confronting anything mathematical may spill over to computers.

We do not know to what extent stereotyping and anxiety that affect female performance in math will also affect participation and performance in computer education. The belief that computer aptitude is related to math aptitude could influence a teacher's decision to assign female students time on the computer. It could discourage female students from taking advantage of opportunities to learn about computers, and keep them from exploring computer-related occupations. The underrepresentation of females and minorities in advanced math and science courses and in scientific occupations has been well documented. The extent to which these factors will affect enrollment in computer instruction and computer-related occupations is yet to be determined.

Research indicates that black males demonstrate positive attitudes toward learning math and science in elementary and junior high school and their performance is not affected by math anxiety. By high school, black male performance declines, seemingly affected by negative teacher expectations. Teachers tend to see black students as lower achievers and white students as higher achievers even when performance is identical (Woodworth and Salzer, 1971; Antonopolis, 1972; Crowl, 1971). Teachers also tend to classify mathematics as higher order learning and, therefore, inappropriate for the black students whom they perceive as lower achievers. Thus it seems likely that math and science may be perceived by many teachers as a white-male domain, and that the most positive expectations are communicated to white males.

Once again, we do not yet know if teachers' attitudes about minority participation in math and science will "spill over" and affect black participation in computer education. However, with a limited number of computers in each school, there is a danger that student selection for computer experiences may be affected by student anxiety and teacher and student stereotyping.

Bias in Computer Programs

In addition to the question of who uses the computer once it is available in the schools, there is the concern of how the computer is used. What kinds of skills will be taught with the computer? Educational programs may reflect the biases of the teacher or program developers. Teachers may tend to underemphasize the need to develop higher order skills with students who have been labeled low achievers. These students may be tracked into drill and practice programs and never taught computer programming or be exposed to more exciting simulations that build higher order skills. Since teachers are more likely to label black students as low achievers even when their performance is identical to white students, it is possible that teachers are more likely to give black students drill and practice, and reserve simulations and programming, which teach higher order skills, for white students. In short, white students may be taught to control the computer while black students are taught to see it as a task master.

In a similar fashion, male students might be given greater opportunities to explore higher order skill building through simulation and educational gaming while female students are tracked primarily into word processing and record keeping. If some students are given word processing and drill and practice and others educational gaming and simulation, time on the computer may be used as a reward for certain groups of students and as a punishment for others.

Additionally (although no research is reported in this area), existing educational software may be more attractive to students with a particular learning style. For example, it is possible that the current emphasis on competition and violence in computer games and in some computer-assisted instructional packages may make computers more appealing to male students. Finally, as with textbooks, computer-assisted instructional packages may contain race, sex and language bias, stereotyping, and exclusion or underrepresentation of the accomplishments of females and/or minorities.

Conclusion

In today's rapidly changing society, an individual should be prepared to pursue as many as three or four careers in a lifetime. The need for this flexibility will become the rule rather than the exception. Eli Ginzberg has advanced the thesis that, in the structural transformation that has taken over the U.S. economy in the last 50 years, human capital has become the critical input that determines the rate of growth of the economy and the well-being of the population. It is our role as educators to ensure that the combination of new knowledge from research in cognitive science and the revolution in low-cost information technology will significantly improve the quality of education for all of our students, thereby increasing human capital and improving productivity. To accomplish this it is essential that we pay careful attention to the issues of computer equity.

SUMMARY OF EQUITY ISSUES

Issues related to computer equity for students who are disadvantaged, female, or members of racial and/or ethnic minority groups fall into three areas: (1) access to computer literacy and computer-assisted instruction; (2) tracking through differential uses of computer technology; and (3) exposure to bias and stereotyping in educational software. Key questions for each of these three areas follow:

1. ACCESS TO COMPUTER LITERACY AND COMPUTER-ASSISTED INSTRUCTION

A. Do school districts with lower tax revenues have fewer computers than do districts with higher tax bases?

B. Are the schools with the fewest computers situated in lower socioeconomic neighborhoods where parents are less likely to have personal computers in their homes?

C. Within an individual school district, are there fewer computers in schools with less influential and/or less affluent parent groups?

D. How are students selected for computer instruction? Are computers considered more appropriate for certain groups of students on the basis of their academic achievement, sex, race/ethnic group, learning disability or socioeconomic level?

E. Is the math anxiety sometimes experienced by females transformed to machine anxiety that limits female students' access to computer technology?

F. What role do teacher and student expectations and stereotyping play in the selection of students for computer time?

G. Is there differential access to staff development activities so that teachers of certain students (minority, handicapped, lower achieving students) are less likely to have access to computer literacy and computer-assisted instruction?

2. TRACKING THROUGH DIFFERENTIAL INSTRUCTIONAL USES OF THE COMPUTER

A. Are higher achieving students using the computers for simulations and development of higher order skills while special education students and lower achievers are restricted to drill and practice activities?

B. Are male students given opportunities to explore higher order skills and simulations while female students' opportunities focus primarily on word processing and recordkeeping?

C. Is time on the computer seen as a reward for certain groups of students and as a punishment for others?

3. EXPOSURE TO BIAS, STEREOTYPING AND NEGATIVE VALUES INHERENT IN THE EDUC TIONAL SOFTWARE

A. Does educational software emphasize one learning style that has a negative impact on certain groups of students on the basis of their race, ethnic group, sex or cultural background?

B. Does the educational software use language that reflects bias on the basis of race, sex, ethnic group or disability?

C. Does the educational software (text or graphics) reflect stereotyping on the basis of race, ethnic group, sex or disability?

D. Does the educational software present the contributions of racial and ethnic groups, females and males in unrealistic and/or historically inaccurate ways?

E. Are females and minorities excluded from or underrepresented in either the text or graphics of the educational software?

F. Does the educational software employ violence or extreme forms of competition for either instruction or rewards for successful completion of the instructional task?

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MICROgram
Newsletter of the Consortium for Quality in Educational Computing Products Vol. 1, No. 4 March 1983

This month's MICROgram deals with two important social and ethical issues facing all computing educators. We hope that the information, ideas, and suggestions presented will help our readers think through their own responses to the problems and opportunities implicit in these issues.

Computers & Equity

SCHOOLS HAVE A RESPONSIBILITY TO PROVIDE COMPUTER EXPERIENCES TO ALL

We are encouraged whenever we hear people in educational computing speak out about the need for equitable distribution of computing knowledge and computers themselves among the economically less advantaged. One of the more articulate statements about this pressing problem appeared in a recent issue of Info World, (January 31, 1983) written by William Puetz, a student of applied computer science at Illinois State University:

> "The most critical problem we'll face by pushing for computer literacy is a widening split of the already strained divisions between social and economic classes. The only children truly able to achieve familiarity with computers will be those of parents wealthy enough to support their quest for knowledge.
>
> The ghetto child won't have quite the same opportunities for exposure to computers -- his gateway to computer literacy will be closed. Not only is this morally objectionable, it is a potential catalyst for a social upheaval we may not survive. Pushing the underprivileged deeper and deeper into the gutter can't solve any problems, but assuredly will create problems we cannot cure.
>
> It is imperative that we not blindly pursue this goal of computer literacy. We must closely examine the directions in which the Information Age is sweeping us and avoid conflicts with which we cannot cope. Computer literacy can mean significant and valuable alterations to our future, but it will be a positive development only when it is available to all."

Mr. Puetz's words prompt us to urge all computing educators to work together to make computer literacy and computer use available to the less economically advantaged members of our society -- on a family basis. The more we observe the spread of knowledge about computers in our society, the more we are convinced that learning about computers is a family learning experience. Certainly many of the middle-class families who are able to afford a home computer seem to see it that way -- even though their children may have ready access to computers at school. Educators should recognize this phenomenon and work with it -- for all families.

HOW SCHOOLS CAN HELP

Schools should offer hands-on workshops for parents in order to put them in direct touch with how their children are using computers in school -- and to show them ways they can work with their kids at home to extend and enhance those in-school experiences. Parents who have purchased or are thinking about purchasing a home computer will be very grateful for this help.

But what about those families who can't afford to buy a home computer? This, of course, is the hard-core of the computers and equity issue. It's a hard-core problem that's got to be dealt with by educational policy-makers, school boards, and legislators across the country before, as Mr. Puetz put it, "The only children truly able to achieve familiarity with computers will be those wealthy enough to support their quest for knowledge." The time is now, if we -- as a society -- are to avoid turning today's economic imbalances among our families into a permanent intellectual disenfranchisement for the less well off.

PUBLIC EDUCATION'S PAST ACHIEVEMENTS AS A MODEL

If this is to be avoided, the public schools of this country must accomplish the same sort of job they once did for verbal literacy with the task of computer literacy. During the early decades of this century when public schools undertook the job of teaching verbal literacy for our society, local schools taught the kids during the day and conducted "night schools" for their parents and their older working brothers and sisters during the evening hours.

But the teaching and learning of verbal literacy required only simple inexpensive readers and simple composition books -- not expensive high-tech equipment. And once basic verbal literacy was achieved, the newly literate could turn to the public library for free, at-home access to a constantly updated supply of free reading materials. (Access which was achieved without the use of copying machines and infringing on a publisher's copyright.)

WHAT ARE THE CHANCES FOR SUCCESS?

Given these differences in expense and access between verbal and computer literacy, what are the chances that our public schools and our public libraries can provide the same sort of universal access to computer literacy during the last decades of the 20th century as they provided to verbal literacy during its early decades? Some will say those chances are not very great. But we hope others will try to increase those chances by helping to develop creative, provocative policies within their schools, their communities, and their states that will increase the chances of success. While they are at it, they might even get the Congress to consider broad-based computer literacy legislation to replace the narrow "Apple Bill" that the U.S. Senate, correctly, has rejected as serving a "special interest." The possibility that all this will happen may not seem very great at the moment. For instance, at present we know of only one school system (Houston, Texas) that is actually implementing a policy of free at-home access to computers accompanied by free parent training in the at-home use of computers. We urge other school districts to follow Houston's example.

A POLICY SUGGESTION

We also suggest that district school boards consider adopting an extension of the policy suggestion made in last month's MICROgram (February 1983-Vol. 1, #3,). Our suggestion was that all parents who attend school-sponsored computer literacy workshops should be eligible to purchase a home computer through their school's 20-30% educational discount and extended warrantee and service agreement that schools are in a position to demand from manufacturers. Under such a policy: parents benefit, (they get a discount and more service) the school benefits (by having home-school computer compatibility), and the school's computer vendor benefits (by potentially being able to sell many more computers to homes than he'd probably ever sell to the local school).

Under such a policy, everybody seems to win. Everybody, that is, except those families that can't afford to purchase a computer a even a 20-30% discount. It seems to us that a variation on the Houston plan of free at-home computer access can be used to help these economically disadvantaged families. The variation would go like this: for every nth computer the school's vendor sells to the parents who can afford to buy one, the vendor (or, more likely, the manufacturer) donates a computer to the school. These donated computers are then made available to disadvantaged families on a free-circulation basis in conjunction with computer-literacy training. We think such a policy is worth trying. We could begin by aiming it at the 11 million families the Census Bureau says are below the poverty level. If you think your school board ought to consider this approach to the computers and equity issue, you might want to direct the board's attention to the current issue of the American School Board Journal, (March 1983) where we have spelled out these and other related policy suggestions in greater detail.

The Copying Problem

ETHICS IN MICRO-COMPUTING: TO COPY or NOT TO COPY

Computing educators are often forced to face the ethical issues of whether or not to copy commercially marketed software for our undeniably legitimate educational use. Understanding the real issue here is of primary importance: by deciding to copy are educators teaching students, by example, that copying data from copyrighted discs or tapes (other than the usually allowable making of a back-up copy) is permissible? Disallowing the issue of whether the software and courseware industry understands the needs of the educational community (and the educational community's responsibility to the companies it does business with) administrators and teachers should take a very careful look at how their attitude regarding software piracy may influence their student's behavior.

The response, "Everyone's doing it!" is not acceptable; ethically or legally. The Supreme Court has just decided the video-tape copying controversy and a major university is currently being sued for copying print material. Micros may well be next, unless educators fulfill their role as teachers -- by example -- of an ethical framework for dealing with this important ethical issue. They can do this for their students by (1) challenging a system that says software piracy, although undetectable and easy, is permissible and (2) airing this issue openly in meetings with students, colleagues, school boards, and parents.

Of course, for every protective device written into a piece of software, a way around will be found. In fact, often the protection device itself is seen as a challenge by bright students; like solving a giant jigsaw puzzle or a monumentally complex equation. Educators must be careful not to subtly reinforce these attitudes in their students, and to air the ethical issues involved.

Of course, there are those who will respond to the above with: "Ethics should be taught in the home." True, but not solely in the home. If we, as educators, choose to avoid the software piracy issue by using the "at home" escape hatch, are we justified in calling ourselves educators? Or even law-abiding citizens?

We urge you to discuss this issue in your school district. As an aid to making your discussions as informed as possible, we want to call your attention to some things that are going on in the marketplace in response to the copying problem.

1. Backup copies must now be provided to consumers by law in some states, either at low cost or, better yet, as part of the original purchase price. This obviates the need to copy, using "backup" as a rationalization.

2. Multiple machine license - a license to copy at a discounted rate can be issued to an individual school principal for use in an individual building.

3. Local network license - in schools where micros are tied to a central CPU and only one piece of software may service many students, the software may cost two or three times the single sale price, negotiable with the manufacturer.

It is rumored that Radio Shack and Gregg/McGraw Hill are granting multiple sale discounts of 50% on ten or more pieces of educational courseware. Distributors and retailers are rebelling at selling to school districts where copying is condoned or actually encouraged by teachers and/or administrators. In some districts (in parts of Florida in particular) superintendents and principals have taken a firm stand, in writing, against copying -- assessing penalties for those caught in the act. We are told that distributors flock to these areas, knowing their products will be protected, and often offer generous discounts to those schools.

The copyright laws are a fact. Rather than ignoring this fact and breaking the law, school consumers must cooperatively reinforce those companies that are trying to come up with reasonable and affordable alternatives to the practice -- and the teaching -- of illegal behavior.

Second-Class Citizens?

FROM VIDEO ARCADES TO KEYBOARD CAMPS, GIRLS FIND THE WORLD OF COMPUTERS A MOSTLY MALE DOMAIN.

BY SARA KIESLER, LEE SPROULL, AND JACQUELYNNE S. ECCLES

Within a few years, according to some industry estimates, computers will be the primary tools in 25 percent of all jobs. Increasingly, computer literacy is becoming an essential skill in the marketplace. One computer ad, for example, shows a young job applicant sinking lower and lower in his chair as he is forced to admit that he does not know how to program.

Children who are exposed to computers early on are most likely to develop "computer efficacy," learn procedural thinking and programming, and develop the sense of mastery that will encourage them to tackle more complex computer tasks.

The culture of computing is overwhelmingly male. With few exceptions, men design the video games, write the software, sell the machines, and teach the courses. Most games, according to Dan Gutman, editor of *Video Games Player*, are "designed by boys for other boys." Until recently, boys outnumbered girls in programming courses and in computer camps by as much as eight to one. (In recent years, however, according to officials at several computer camps, the enrollment ratio has dropped to about three to one.) If this bias leads to an equivalent gap in competence and confidence, the girls of today will undoubtedly become second-class citizens.

At first, computing is a strange and potentially humiliating activity, and girls need to be encouraged to take the initial plunge. The stylized nature of computing, and its arbitrary conventions, can be threatening. But those boys and girls who do acquire some proficiency usually advance rapidly. They learn discriminating attitudes toward games, machines, software, and programming styles. They learn to

Reprinted from Psychology Today, March 1983.

LIKE THE POOLROOM OF YESTERDAY, TODAY'S VIDEO ARCADE HAS BECOME A MALE PRESERVE, WHERE BOYS GATHER TO TEST THEIR SKILL.

work their way through the complexities of computing syntax, devices, and programs. And they learn the language and values of "hackers"—those who spend most of their free time "fooling around" with computers.

Most children receive their initiation into the world of computers by playing video games in the arcades, at home, or at their local computing center. One study of children who had home computers found that 67 percent of those over 12, and 88 percent under 12, used them to play games, along with other activities.

The video arcade is a den of teenage male culture, a place where teenage boys gather with their buddies. Occasionally they bring their girlfriends, whose main role is to admire the performance of their boyfriends, not to play themselves. In an informal survey we made on several busy Saturdays in a suburban Pittsburgh shopping mall, we found the video arcade populated overwhelmingly by boys. Of the roughly 175 people we counted, only 20 were girls. We saw several groups of girls playing the games; all the other girls were with boys. Not once did we see a girl playing alone.

The software sold for home computers offers an array of land battles, space wars, and other forms of destruction, as well as typically male sports. This bias is reflected on the colorful covers of the game packages. On the rack in one store, for example, we found such games as Olympic Decathalon (four male athletes on the cover), Cannonball Blitz (five men in battle), and Swashbuckler (seven pirates). In all, there were 28 men and only four women depicted on the game packages that we saw on this rack. This bias is unlikely to attract girls to such games.

In the arcades, however, things are beginning to change. For example, Pac-Man, and a dolled-up version called Ms. Pac-Man, seem to appeal especially to girls. This year, each of these arcade games produced record sales of nearly 100,000 machines. Industry executives, trying to take advantage of the still largely untapped market of female players, are turning out an increasing number of non-macho video games designed with enough whimsy to appeal to girls. (See "Crosstalk": Play, page 10.)

Computer stores are also an alien environment for most girls and women by virtue of the very products they stock. Most women are not familiar with electronics equipment, wires, and related accessories. This comes as no surprise, since the first customers for these stores were mostly male electronics hobbyists of the sort who used to build their own stereos. Computer stores are, in fact, electronics stores. The operators and sales people are mainly male, usually young, and often fervent advocates—to male customers—of computing as a way of life.

Even the educational software designed for children bespeaks a young, male culture. As Mark Lepper, a Stanford psychologist, points out, "One sees . . . a variety of presumably educational games that involve the same themes of war and violence that are so prevalent in video-arcade games, and another large class of programs that involve largely male sports—baseball, basketball, and football. In the game of Spelling Baseball, for instance, the child's reward for superior performance is the opportunity to see one's own baseball team outscore the computer's team. When one watches children exposed to these games, it is hard to avoid the conclusion that these choices are not optimal for interesting girls in the world of computers."

Another obstacle for girls entering the world of computing is the visual format of the video games. Zooming through space, dodging asteroids, and shooting down alien battle cruisers are all spatial tasks. They require quick judgments of spatial relationships and intricate hand-eye coordination, and maneuvers based on those judgments. Accumulating evidence suggests that boys, on average, have an advantage over girls in just such spatial abilities. In a thorough review of the field in 1974, Eleanor Maccoby and Carol Jacklin, in *The Psychology of Sex Differences*, confirmed the fact that boys excel in visual and spatial skills, particularly in tasks that require depth perception and solving mazes—both essential skills for many video games. (Of course, these differences may also be partially due to social factors, like different styles of child-rearing for boys and girls).

One would expect from these research findings that boys would easily outscore girls on most video games, and that girls' supposedly inferior spatial abilities may be discouraging them from competing in the arcades. But in fact, girls can score just as high as boys on video games—if given a chance to master them. Carl Berger, professor of education at the University of Michigan, gave 100 boys and girls a chance to practice on a nonwarlike—and therefore sexually unbiased—video "dart" game in which the players estimate the position of a rising balloon, and then try to pop it. At first, the girls in this study did worse than the boys. But after practicing for 10 complete games each, the girls began performing as well as the boys.

Finally, the computing culture appeals to the rebelliousness of teenage boys. Indeed, the professional computing community preserves many counterestablishment attitudes. Some hackers engage in such borderline activities as pirating software, unlocking telephone lines, or gaining illicit access to computer systems. The computer culture has bred a new kind of male punk, who prides himself on his talents at breaking codes, illegally copying computer games, and overloading time-sharing systems. Some even send electronic chain letters that can overwhelm networks. Children generally are not taught any computer etiquette; on the contrary, they are exposed to mostly male role models who teach them to break rules. As their skills increase, children on a system shared with adults can be truly destructive. At the computer summer school at Carnegie-Mellon University, for example, boys purposely ran programs using so much memory that the entire system's capacity was swamped. The network for the entire university "crashed" to a halt.

All of these observations suggest that the male bias in the culture of computing may explain the difference in girls' and boys' attraction to computing. It is a world of electronic poolrooms and sports fields, of circuits and machines, of street-corner society transplanted to a terminal room. Hardly the kind of world girls find enticing.

We believe, however, that there is nothing intrinsic to computing that should discourage girls. The social aspects of computer use appear to be the main stumbling blocks. In fact, the very first computer programmers were women, hired by the Navy during World War II to calculate shell trajectories on mechanical calculators. When ENIAC, the first operational computer, was built, women were assigned to program it. They became known as the "ENIAC girls." Unfortunately, it was because programming

GIRLS SHOULD NOT BE DISCOURAGED BY COMPUTING. PROGRAMMING IS MORE LIKE FOLLOWING A RECIPE THAN FIXING A BIKE.

was initially viewed as an occupation of low importance that it was assigned to women.

There are signs, however, that girls are finding their way into the world of computing, despite its male bias. A large proportion of the current enrollment in college computer classes is female. For example, at Mount Holyoke, a women's college, 50 percent of this year's graduates have used computers in their courses—up from 15 percent seven years ago. According to John Durso, professor of computer studies, the number of terminals available to Mount Holyoke students has increased from one to 40 over the same period. "The basic course in computing, taught twice a year, has qı ⁻drupled in enrollment from 30 students seven years ago to 120 today," says Durso.

Some people claim that little can be done to increase girls' interest, because of sex differences in early socialization. Recent surveys have shown large differences between boys and girls in acquiring sex-linked skills. Young boys, for example, are more likely than girls to be able to repair a radio or bicycle; girls are more likely to be able to cook a meal or repair clothes.

But computers are not machines in the traditional sense. The essence of computer literacy is really procedural thinking. There is no evidence that girls are deficient in this respect, or that their early training and interests are inconsistent with it. Indeed, computer programming is more like following a recipe or pattern than fixing a bike. If some of the initial alienating elements were removed, girls would be as likely as boys to take the steps toward computer efficacy.

To what degree are sex differences in game choice cultural? One clue may be the large number of women playing video poker, a new and relatively rare addition to gambling casinos. Anyone who goes to a casino will see strong sex differences in the choice of games. Men gravitate to craps and poker—confrontational, aggressive, put-yourself-on-the-line games. Women play less competitive games, like slot machines, which, unfortunately, offer worse odds.

The appeal of video poker for women, however, suggests that poker is not inherently distasteful to women, but rather that ordinary poker, played face-to-face, is somehow less attractive. We guess that poker and craps are both discouraged and discouraging for most women. They are masculine activities, and playing them usual-

ELECTRONIC LEARNING
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MICROS AND THE DISADVANTAGED

WHY WE'RE MISSING A GREAT OPPORTUNITY

The microcomputer could help narrow the gap between our society's "haves" and "have-nots." Instead, it may leave that gap wider than ever before.

"Them that got is them that get."
—Ray Charles

When Ray Charles used to sing that line, he probably wasn't thinking of schools and computers.

But he might as well have been.

We believe that unless government or educational forces intervene soon, we are in danger of creating a new class of disadvantaged: the computer illiterate. We're afraid that because the "schools that got"—i.e., schools in the nation's wealthier districts—are largely the ones acquiring computers nowadays, their students will largely be the ones getting the exposure to technology they'll need to thrive in a technological society. We're afraid that other children, who for economic or social reasons are disadvantaged today, will face unchallengeable handicaps tomorrow—because they will not have had that exposure.

And we're disappointed that within the vast (and growing) volume of literature dealing with the educational impact of microcomputer technology, so little attention seems to have been given to these implications for social equity.

It has only been four or five years since the microcomputer first began appearing in classrooms around the country. And already a combination of deeply-seeded economic and social forces are giving shape to trends in microcomputer distribution and use. Consider the following factors:

1. Computer Accessibility. Although there are over 100,000 microcomputers already in schools, this represents fewer than one micro for every 400 students nationwide. While some schools are able to afford computer laboratories with adequate numbers of computers, other schools have no computers at all. And even though hardware costs continue to decline, capital expenditures of the magnitude required to provide enough computers for meaningful instructional applications look to become even more difficult for many schools in the future. That's because of decreases in the federal and other discretionary funds upon which many districts have historically relied to implement innovative programs. Federal funding cutbacks under Chapter 2 of the Education Consolidated and Improvement Act (ECIA) have already reduced funding to the major cities from $110 million in 1982 to $38 million in 1983; policy changes in the Act will mean that schools which already have adequate access to computers and which already have funds to purchase hardware will receive a greater percentage of what little

> IT HAS BECOME APPARENT THAT VERY LITTLE QUALITY SOFTWARE TARGETED TOWARDS THE DISADVANTAGED IS BEING PRODUCED.

Richard S. Podemski
Associate Professor, Educational Administration
University of Arkansas
Fayetteville, AR

Sam Husk
Executive Director
Council of Great City Schools
Washington, DC

Aubrey B. Jones
Former member, Project PRIME (Philadelphia Regional Introduction for Minorities to Engineering), and author of the "I speak BASIC" series for the Hayden Book Company, Rochelle Park, N.J.

Chapter 2 money there is.

The difference in "computing opportunity" for students in school districts with large concentrations of the poor and for those in more affluent communities has already reached critical proportions. According to a survey undertaken by Market Data Retrieval, Inc. in October 1982 (and reported in the January *EL*), 44 percent of schools in the wealthiest districts have micros, compared with only 18 percent of schools in impoverished districts.

2. Motivation to Adopt. Middle and upper class parents have been most vocal in demanding that their schools adopt microcomputers. Since these parents are more likely to have computers in their home or use them in their work, they sense the importance of computer competence for the future job success of their children. This parental awareness is less evident among low socioeconomic class parents who may not have been fully exposed to computers, and who may not fully appreciate the impact they will have.

The result of these differences in parental background, of course, is that more affluent, suburban schools will be first to integrate the computer into the curriculum. Without this parental interest (and pressure), large inner city school systems may not react as quickly—if at all.

3. Preparation of the Individual to Learn. There are two parts to this problem. One has to do with differences in the backgrounds of students from high- and low-income families and communities. Members of the latter group may simply not have had the exposure to math, science, or technical education needed to appreciate the value of computer literacy as a job skill.

Creatively-designed software aimed specifically at this type of student might help ease that problem, but it has become apparent that very little quality software targeted towards the disadvantaged is being produced. That's only logical: in order to stay in business, software producers must market software that will sell. Unfortunately, without financial help from somewhere, that counts out much in the way of programming for the disadvantaged.

4. Attitudes of Teachers. In many schools, computing is a hot item, the latest thing. Often, computer literacy and competence is viewed as something reserved only for the academically gifted, or to be used only as a supplement. Other educators who work with disadvantaged students may feel pressure to concentrate on basic reading and math skills, instead of teaching computer literacy skills. Either way, the opportunity of the underprivileged child to study computing is undercut.

There is a terrible irony in all of this, and that is that the microcomputer represents such wonderful possibilities as a *tool* for social equity. By itself, the computer is nothing more than an instrument—a totally non-judgmental, non-culturally-biased tool. Its language is symbolic, and need not be grounded in any one spoken language nor any specific cultural experiences. Seymour Papert's research with LOGO, for example, has demonstrated that young children can easily master a computer language long before they master formal English—and can use the symbolism of LOGO to express themselves in ways they could not through formal spoken language.

It should be possible, then, for educators to use computer languages as a means of transcending specific formal language or experience barriers. Like music, computer languages have the potential to become universally understood—and manipulated.

There is more: the value of a computer can reach way beyond the keyboard's borders. Studies have shown that children who are given the opportunity to program computers often develop a sense of personal fulfillment they don't acquire through traditional learning methods. That's because they are, for the first time, being put in control of their own education. This positive self-image can lead to greater enthusiasm for learning in other, non-computer-related areas as well.

THERE IS A TERRIBLE IRONY IN ALL OF THIS, AND THAT IS THAT THE MICROCOMPUTER REPRESENTS SUCH WONDERFUL POSSIBILITIES AS A *TOOL* FOR SOCIAL EQUITY.

There is much to be done. Happily, educators in some cities have already begun work on some of the issues we've mentioned above. The school systems in Boston, Detroit, Houston, Cincinnati, and Salt Lake City have formed a special consortium to address the situation and suggest alternatives. The District of Columbia has made a significant investment in computer literacy programs, with pilot projects in 50 Title I low income elementary schools. The federal government even shows signs of getting into the act: several bills aimed at assuring equal access in schools to the new technology have already been introduced by the new Congress.

These are all good signs, but they are not enough: our educational system and our society have too much at stake. Our technological future demands that we make full use of our human resources—that we create a work force skilled enough to handle the highly technical jobs of the 'Eighties and 'Nineties. But in so doing, we can perform another great right: we can help narrow the gap in our society between the "gots" (as Ray Charles might put it) and the "ain't gots." Technology has given us the key; all we have to do is use it. **EL**

CAN COMPUTERS CLOSE THE EDUCATIONAL EQUITY GAP?

by James P. Johnson

"To illuminate the blackness of his invisibility," the protagonist in Ralph Ellison's *The Invisible Man* ripped off whitey's Monopolated Light and Power Co. By tapping the power line he used bootleg electricity to run the phonograph and 1,369 bulbs in his basement hideaway—a kind of electric cavern—on the edge of Harlem.

Ellison created this powerful image in 1947. No longer invisible, blacks and other minorities in America have begun to join the mainstream. In 1982, Ellison's Invisible Man has moved out of his electric cavern. But can he afford to move into an "electronic cottage" wired with the marvels of the new technology?

"Probably not," says Alvin Toffler in an article in the Summer 1982 issue of *Perspectives*. "As home computers proliferate... white middle class children will start out, once more, with an edge that the less affluent lack."

That computers are revolutionizing America, there is no doubt. Miniaturization has made possible the home computer, even the $100 computer. Americans have bought over a million computers. Nearly every American home has a TV, and "someday soon," one Dallas computer salesman said, "every home will have a computer. It will be as standard as a toilet."

"To take a simple analogy," says Georgia Congressman Newt Gingrich, "if the automobile industry had changed as much as the computer industry, you could buy a Cadillac for $2.95, it would get three million miles to the gallon, and you could put seven of them in your briefcase."

Whether we like it or not, we are being catapulted kicking and screaming into a computerized world. There's a computer in the microwave oven, in the stereo system, and under the dashboards of many automobiles. New lines of watches and hand calculators contain tiny computers.

While there is some dispute as to exactly how computer literacy will pay off for today's students when they enter the job market, the U.S. Labor and Commerce Departments and IBM predict that by the end of the decade, 50 to 75 percent of jobs will be computer-related. In offices, where most new jobs will be located, word processors, computerized filing systems and desk top computers are already bringing dramatic changes in work patterns and productivity. In factories, hospitals and other labor-intensive sectors of the economy, robots are expected to take over many more of the risky or repetitive chores now performed by humans.

Some fear the impact of robotization on the labor market and working conditions. A survey in Japan, which is ahead of the U.S. in the use of robots, found that 97 percent of in-house unions and 79 percent of management think robotization will lead to increased unemployment. Not surprisingly, such studies have received careful attention by union leadership here. Clearly, the job applicants most qualified to perform the growing number of high-technology jobs that are appearing on the horizon are likely to be the ones with the highest degree of computer literacy. The unskilled jobs historically filled by new immigrants and those at the bottom of the economic and education ladder, especially those on factory assembly lines, are fast dwindling and will all but disappear. To compete for tomorrow's jobs, kids must become familiar with computers today.

To be sure, kids can't acquire quarters fast enough for Donkey Kong, Asteroids, or Pac Man. Now instead of having a "Big Mac attack," students have "Donkey Kong attacks" and duck into the nearest arcade. Computer games, the amusement industry spinoff of the information revolution, teach the players just enough to keep the quarters dropping. Computer literacy, however, won't be aquired in video game arcades. It will be developed at home and in schools.

CBS and AT&T have launched a joint effort called "Venture One" that will link up computers in homes in Ridgewood, New Jersey, an affluent suburb, with a data bank so that owners can do their shopping, banking, and other chores by computer. Merchants will advertise over the network. A similar program in a wealthy suburb of Columbus, Ohio, has been in place for several years. The "electronic cot-

James P. Johnson, a freelance writer, lives in Westfield, N.J.

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tage" has arrived.

Why did AT&T and CBS pick Ridgewood? "Ridgewood," responded James Bauer, director of business development for CBS, "would seem to be perfect. The residents there are upscale, have a high median income and they're computer literate. The kids take computer education in kindergarten."

Computer literacy won't be acquired in video games arcades. It will be developed at home and in schools.

Does CBS's choice of a rich suburb mean that the computer revolution will bypass minority children? Not necessarily. Federal assistance to school districts with disadvantaged students under Title 1 of the Elementary and Secondary Education Act or through the block grant funding begun in 1981 means that inner city kids may find computers in their classrooms. Those in charge of public education in New York City, for example, are proud of their recent strides in computer-assisted education. Irving Kaufman, director of mathematics for the New York City Public Schools, ticked off the list of heavily minority city districts where computers are now part of the curriculum. "We want our kids," he said emphatically, "to know as much about computers as the wealthiest kids in the country. In the near future every school in the city could have one computer."

Dr. Carl Soloman, Title I evaluator for funded programs in District 16, which encompasses the elementary and junior high schools in Brooklyn's Bedford Stuyvesant section, pointed proudly to his district's courses in computer literacy and its computer-assisted instruction. "Our entire district," he said with mock dismay, "has been inundated with computer salesmen." But, he noted, "we're not getting the money we need. And those districts with money are going to be ahead of us."

The problems for low income, high minority enrollment school districts go beyond the affordability of classroom computers. Indeed, all school districts are facing a host of computer literacy issues that defy easy solution. Congress' Office of Technology Assessment (OTA) reported last September that the U.S. is faced with a shortage of public school science and math teachers, those most likely to lead the way in computer-based education, because they can nearly double their salaries working in the private sector. OTA also complained about the quality of today's computerized lessons ("software"), the shortage of qualified people to prepare the lessons, and the lack of understanding of the long-term educational and psychological effects of substituting technology for traditional teaching methods. Further, there is a growing worry that computers could touch off our next generation gap. A recent Atari advertisement unwittingly contributes this possibility: "Are the kids getting a jump on the grown-ups? We may in a few years see...a generation of men and women shut off from a fundamental part of their children's lives."

Still, while schools must add a complex of issues concerning computer learning to such long-standing problems as the need to improve basic skills, reduce the blight of drugs, violence and truancy in the schools and cope with vexing fluctuations in the school-aged population, the affordability of classroom computers today constitutes a major problem. School budgets are being squeezed by local property tax-revolts, as well as by significant state and Federal budget cuts for education. And, as usual, schools with the largest number of minority students are faring the worst. Dr. Beverly Cole of the educational division of the NAACP echoed Soloman's comment about money. "Inner city schools in general," she said, "just aren't developing computer education as fast as wealthier districts."

Compare, for example, Newark, New Jersey, with suburban Westfield, some fifteen miles distant. In Newark, where riots erupted in 1967, inner city students have been working with computers for over 15 years. Many elementary school students use computers to drill in English and math. The large high school in the system has 16 computers. Eager beavers can take special computer programs at the New Jersey Institute of Technology.

But even this computer commitment does not begin to match that of Westfield, where a high school similar in size to the largest in Newark has twice as many terminals, batteries of courses in computer science and data processing, word processors in the business education department—and a computer to assist students in selecting a college. In 1982–83, Westfield will teach computer literacy to all sixth grade students.

In affluent Ridgewood, N.J., the kids take computer education in kindergarten.

Westfield is not an isolated example. Affluent Montgomery County, Maryland outside of Washington, D.C. has set a four-year goal that will require every high school student to have access to 120 minutes of computer time per week, every junior high student for 90 minutes and every elementary student for 50 minutes. But the state of Minnesota may be on a fast-break to the future. It has mandated computer training for teachers and has equipped nearly all of its schools with classroom computers.

In many districts, concerned parents form the vanguard leading the rush to computerize neighborhood schools. A report by the Association for Educational Communications and Technology says that PTAs are buying close to 20 percent of computers for schools. Yet, the best hope for preventing a classroom computer gap from becoming a serious national problem may lie with Capitol Hill. Congress is now considering legislation to greatly expand tax breaks for computer manufacturers who donate equipment to elementary and secondary schools.

Steven Jobs, 27-year-old chairman of Apple Computer Company and brainchild of what has been dubbed the "Apple Bill," testified in congressional hearings that it was essential to the national welfare that students begin acquiring computer training long before they get to college, and that a tax credit would make the equipment available to schools that otherwise could not afford it. "Leaving this to the colleges in today's environment," he said, "is equivalent to leaving the teaching of English grammar and arithmetic to colleges." With the right tax break, Jobs plans to donate a computer to each of 80,000 public schools in the country. In this scheme, the profits would be reaped when schools purchase programs and other equipment compatible with their computer, and when students persuade their parents to buy Apple personal computers for use at home.

Among the critics of the "Apple Bill" are microcomputer manufacturers who point out that the contemplated tax write-off for donated equipment would only partly offset monumental logistical costs and headaches involved in assuring that units get from warehouses into the hands of teachers and students prepared to use rather than abuse them. Nevertheless, the bill was approved by the House 321 to 61 and cleared by the Senate Finance Committee in the 97th Congress.

Even if the Apple bill passes in the 98th Congress, poor school districts would still find it difficult to provide adequate computer-assisted instruction. According to Ross Corson writing in *The Progressive*, "The reality is likely to be a society of computer literates and illiterates — the haves and have nots of the new age." A survey by Market Data Retrieval Inc., seems to buttress that worry. It found that 80 percent of the country's 2,000 largest and richest public high schools now have at least one microcomputer, while 60 percent of the 2,000 poorest schools have none.

Understandably, civil rights activists have focussed on improving the education of minorities in basic skills rather than ruminate on the impact of computers on civil rights. The NAACP, said Dr. Cole, had yet to examine the impact of "Third Wave" technology.

Lucius Walker, dean of Howard University's School of Engineering, has thought about the civil rights aspects of the computer revolution and proudly explained Howard's pre-college programs in technical subjects for minority students. But, Walker found, the more technical the subject, the fewer minority students enrolled.

"Blacks," Bebe Moore Campbell wrote recently in *Black Enterprise* magazine, "are seven times less likely to become scientists and twelve times less likely to become engineers than whites."

"There is," says Walker, "a mystique associated with technical and abstract subjects. Some of us feel we can't do math and science or succeed in quantitative fields." He calls the phenomenon "math phobia."

"Computers represent a mystique that frightens many blacks," agrees Robert Towns, who runs Fortune Computer Group, the only black-owned computerized patient billing and accounts receivable service in California.

We could become a society of computer literates and illiterates— the haves and have nots of the new age.

To date, weakness in math has been crippling minority children. The National Assessment of Educational Progress studies show that at ages 9, 13, and 17, whites outscore both blacks and Hispanics in knowledge and skill application in mathematics by 13 to 20 percentage points.

"If blacks are not literate in technology," warns Massey, "they will not be able to get into the mainstream and will simply fall further behind than they are now." Dr. Cole agreed that "being conversant with computers will be the difference between being employed or unemployed." "If," Dean Walker added in computerese, "blacks cannot interface with computers, they cannot function in a complex world."

The same applies to women. In her book, *Overcoming Math Anxiety*, Sheila Tobias shows that female students shy away from math and science courses at a much higher rate than males. At one private school, 60 percent of the boys take extra courses in both math and science, but only 25 percent of the girls do so. Tobias attributes this difference in interest almost entirely to what she calls society's "ideology of sex differences,"—the parents, peers and teachers who forgive a girl when she does badly in math at school.

Schools not only teach about computers; they use computers to teach. "The computer," believes Professor Mary Alice White, director of the Electronic Learning Laboratory at Columbia University's Teachers College, "is as revolutionary as the printing press. Learning and teaching will never be the same." Students, Professor White finds, pay more attention to the computer than the teacher, ask it more questions, work cooperatively to solve problems on it, and make no more errors in learning to program a computer than adults do. "Kids like the computer," says science fiction writer Isaac Asimov, "because it plays back. You can play with it, but it is completely under your control; it's a pal, a friend, but it doesn't break the rules." There are 130,000 computers installed in U.S. classrooms at the moment, and there may be as many as 650,000 in 1985.

The Educational Testing Service recently studied computer-assisted education for elementary school students. In mathematics, computer-assisted instruction proved as effective as having a tutor. The more computer time students received, the more basic math they learned. Formerly a nonbeliever in computer-assisted education, Marjorie Radosta, director of the study, now says, "This is the way to go, especially for Title I students or others having problems."

Yet, as Stanford University Professor Michael Kirst wisely points out, "Improved technical education can only be built on a solid base for the overall school program. It is impossible to provide 'literacy' in technical subjects without 'literacy' in language and other skills."

With many teachers using computers only as electronic flashcards for simple drill and practice, many education experts say the educational potential of school computers has been barely tapped, says Allen A. Boraiko writing in *National Geographic*. Just around the corner are learning modules that can boost analytic skills in specific subject areas or make children truly computer literate—able to run and program computers and grasp their impact on society.

"I think we're going to see a world of innovation come out of young kids, high school kids, and pre-teens of all kinds, who are just given access to technology, with creative minds and no constraints," says Dr. Robert E. Kahn of the Defense Department's Advanced Research Projects Agency.

If blacks and women cannot interface with computers, they cannot function in a complex world.

It may well be that the flexibility inherent in current computer technology, enabling users to develop their own learning modules or adapt commercial programs to meet special group or individual needs, represents the greatest long-term benefit for minority, female and physically handicapped children. Enough studies have documented the fact that such students are much less likely than white males to experience sustained contact with positive role models in school classrooms—whether vicariously through textbook illustrations and prose or in the person of science and math teachers—that could stir their aspirations for careers in science, engineering and other math-related high technology fields.

According to *Background Report on Silicon Valley* prepared for the U.S. Commission on Civil Rights last September, "If present trends continue, women and minorities will be left behind in the push to upgrade technical and scientific education. Except for an over-representation of Asian American men, most engineering and science [college] graduates are still white males."

Students and skilled teachers, working independently and in tandem, can create computer programs that contain positive examples of families, neighborhoods, workplaces and professional role models with which children, female or male and of varing racial or ethnic backgrounds, can identify. And this can be done without sacrificing skill and knowledge learning objectives—indeed, in a way that enhances those objectives.

But the computer is already remaking classroom instruction. Many educators now believe that students with access to a microcomputer spend more time studying and solving problems, and that those who write at their keyboards compose more freely and revise their work more thoroughly. "It's a new way of thinking. The kids who don't get indoctrinated to computers by seventh grade are not going to develop the same proficiency," says Andrew Molnar, computer specialist at the National Science Foundation.

While OTA warns that "caution should be exercised in undertaking any major national effort, whether federally inspired or not, to introduce these new technologies into education," today's consensus is expressed by Peter Schwartz, former head of Future Studies at SRI International, a California think tank, when he says "The [computer] chip is remaking this into a world where information is literally wealth."

Neutrality and fairness are integral to computers. The public policies which determine who has easy access to computers and the information wealth they represent may not be. The Congressional Office of Technology Assessment (OTA) recently completed a study of the impact of the information revolution on American education. It directs Congress to consider developing Federal policies for manpower retraining in a computer age, for programs to insure that minorities are not left out, and for helping local educational leaders cope with computer technology. Unless action is taken now, concluded the OTA, "A significant social, economic and political gap could develop between those who do and those who do not have access to, and the ability to use, information systems."

To illuminate his life, the protagonist in *The Invisible Man* once figured out how to tap his city's power line.

To guarantee their livelihood, his children now must gain access to the power potential of the computer. ◆

'Equal' Access to Computers in Education Could Become Major Issue, Experts Warn

By Charlie Euchner

Access to computers, both sides of a 20-year-old desegregation controversy in San Francisco agreed in a recent voluntary settlement, is becoming an integral part of elementary and secondary education—and one in which poorer students are usually left behind.

The December agreement of the two sides and the judge presiding over the case to create a special school for computer training underscored the position of a growing number of educators that access to computers and computer training is further separating education's "haves" from its "have-nots." And some note that the widespread use of the new technology is such a profound development that the inequities could threaten the basic value of free access to public education.

"We're training an elite set of people," said Carolyn Marvin, assistant professor of communication at the Annenberg School of Communications at the University of

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'Equal' Access to Computers Is Issue

Continued from Page 1

Pennsylvania. "Power is the information available to you. A whole array of information is not available [to those denied computer literacy]."

Although the San Francisco settlement marks the first time that access to computers has been part of a legal move to redress inequities in education, some educators said that, given the inequities of computer use in schools, the legal attention was inevitable and is likely to increase in the years ahead.

Survey Results

Surveys show that in the number of computers available and the way they are used, students in less affluent schools receive less sophisticated instruction than students in more affluent schools.

Forty-four percent of the schools in which fewer than 5 percent of the students came from families below the poverty level have computers, an October 1982 survey by Market Data Retrieval found. Only 18.3 percent of the schools with more than 25 percent of students from lower-income families had computers.

Another survey, conducted last year by California's education department, showed that students in the poorer districts who do use computers are still not exposed to the "higher order" skills that will be necessary to compete in an increasingly service-oriented economy.

The state classified schoolchildren by their parents' occupations, with professional occupations given a rating of 3, skilled workers, 2, and unskilled workers, 1.

The average occupational rating for the parents of students in computer-assisted programs was 2.19. The rating for students learning "computer literacy" was 2.32.

The same trend appeared in breakdowns of subjects studied with the computer. The ratings for students using computers for simulation and games, programming, and creative applications were 2.28, 2.35, and 2.40, respectively. The ratings for reading, vocabulary, and mathematics drills were 2.08, 2.12, and 2.16, respectively.

'Probably' Same Nationwide

Arthur Luehrmann, a partner with Computer Literacy Inc., a research firm, said that those figures are "probably"the same nationwide.

A survey for the National Assessment of Educational Progress (N.A.E.P.) has found that schools in the Southeast offer significantly fewer classes involving computers. For example, 23 percent of a national sample of 13-year-olds said they had used a computer in school, compared with 12 percent in the southeast.

The 1981-82 N.A.E.P. survey, which will be released this April, found fewer disparities in computer use by race and sex.

If the gap is not narrowed, Ms. Marvin of the Annenberg School suggested, students from low-income backgrounds will be powerless to move beyond the unskilled computer jobs. "They're going to end up being the airline reservationists," she said. "That's not very powerful."

Home computers are widening the gap, educators point out. "Access has come primarily through home computers," said Joyce Hakannson, the president of Joyce Hakannson Associates, a software manufacturing company. "That threatens to create a much larger gap" between those whose families have home computers and those whose families do not.

Although there are no nationwide statistics correlating income with home-computer purchases, market analysts say the professional groups tend to buy machines sooner than others—and use them for more educational purposes.

Training Is a Top Concern

Even when computers are available, ensuring that they will be used "wisely" is a difficult problem, according to computer experts and educators. And the problem is apparently a human rather than a technical one.

"The equipment problem is diminishing, because the price of computers is going down 50 percent every two years," said Mr. Luehrmann of Computer Literacy. "The cost of a computer lab for each school would add one-half of one percent to the school budget over five years."

Marc S. Tucker, a former National Institute of Education policy director who is conducting a 20-month study of computers in education for the Carnegie Corporation of New York, added that computers that sell for as little as $100 might be appropriate for some school uses.

But without proper teacher training, the computers will do little to prepare students for many of the jobs that will be available in coming decades, he said.

Joan F. Targ, the president of Interactive Sciences Inc., a private computer-training firm, said that only a nationwide effort would give the poorer schools the teachers they need to use computers wisely.

"The poor schools will have a tough time getting at a small pool [of qualified teachers]," Ms. Targ said. Most of them "are using the drill-and-practice programs—going in for 10 minutes a day for what they're having problems with."

"The aide in there doesn't know anything about computers except how to load a floppy disk into the machine."

Such a situation is common, Ms. Targ said, suggesting another problem: the possibility that many poorer schools will use the computer as much to cut costs as to improve instruction.

"It's a way of economizing," she said. "By hiring an aide to run the computer center, you don't have to have as many teachers."

An "extreme" example, she said, is a San Jose high school's use of video games during lunch periods—which serves as an incentive for students to attend school and thereby increases state aid.

Training Proposed

Government-subsidized programs, most educators said, are necessary to ensure that teachers from all levels can be reached with the training needed to narrow the gap.

One teacher for every school building can be trained relatively inexpensively, suggested Ms. Targ. "One person from every school could be trained for a total of $1.5 million in California," she said. "If districts, especially the poorer ones, could be given scholarships for this, it would go a long way."

"If you can find a teacher who . . . can *believe* that for the students to qualify for jobs they need a real knowledge of computers," agreed Mr. Luehrmann of Computer Literacy, "that will be a good start."

Computertown U.S.A., a California computer education firm, has set up 200 "libraries" nationwide to give everyday computer access to less affluent areas. It is, said one official at the firm, "simply a place where people can go to find out more."

Unequal School Funding

Whatever government training programs are enacted, contended Ms. Marvin of the Annenberg School, will not be enough until the larger problem of unequal school funding is addressed.

"There's already a large group out there that can't read or write, and you have to deal with that first," she said.

"You can't simply superimpose the computer and not deal with problems like teacher quality, physical plant, and the academic programs."

EDUCATIONAL LEADERSHIP
September 1983

Computer Fear

To avoid repeating mistakes of past decades, we need to recognize affirmative action implications of the computer bandwagon.

Cynthia Bakon, Antonia Nielsen, and Jamieson McKenzie

The fourth period bell rings, signaling the start of class. The high school computer lab quickly fills with several dozen students, mostly male. Three girls, looking somewhat adrift in this sea of boys, take their seats for an advanced class in PASCAL. The instructor, a highly skilled male math teacher, begins with a demonstration of a new programming technique.

Three hours later, the final bell of the final period sends students hurrying toward lockers, athletic fields, and home. The high school computer lab, however, is once again packed with students. Only, this time, all of them are male.

These scenes are being repeated in school after school. There is growing evidence that the long-documented gap between male and female participation in elective math and physical science courses is now being replicated in computer labs.

The Equity Gap: Real or Manufactured?

In reviewing the literature on differences between males and females in math and science, Skolnick reports a very wide gap:

> Across the nation slightly more girls than boys are enrolled in our schools. Yet studies reveal that twice as many college bound senior boys as girls have taken three years of physical science; and some other discrepancies are evident in advanced mathematics enrollment. In a typical school district boys outnumber girls by more than 2 to 1 in most high school physical science courses, 3 to 1 in physics. Although girls may outnumber boys in advanced eighth grade math, by twelfth grade twice as many boys as girls are enrolled in calculus. As a result, relatively few girls are prepared to take the calculus sequence necessary for many college majors.[1]

A survey of ten New Jersey high schools offering elective courses in computer programming revealed a consistent and substantial male dominance of enrollment in such courses—slightly more than 60 percent. Studies of computer use in California schools support the New Jersey trend:

> The ratio of male to female enrollment was approximately 5:3 (11,441 males to 6,843 females). Enrollment in computer science courses at the University of California, Berkeley, is also heavily male-dominated beyond the introductory courses: only 23 percent of computer science majors at Berkeley are females.[2]

Ensuring Equity

A district implementing or revising a computer education program should take a strong position on sex equity at the onset. Once this position has been clearly stated, program implementation must be shaped accordingly. Among other things, schools need to gather their own data to assess how significantly they are meeting their sex equity goals. Participation in advanced computer programming courses at a high school level should be monitored annually. If this data provides evidence of male dominance, the investigation should probe the foundations of the program. If the district provides substantial computer literacy experiences at the middle or junior high level, for example, and all subsequent computer courses are elective, a sample of incoming high school students should be interviewed to determine why students may be dropping out of computer courses. The inquiry might begin even earlier during the computer literacy courses themselves.

The results of a study conducted at Princeton High School showed that gender, grade, and the type and section of math class were all related to how much students learned. Males, younger students, students in sophomore and junior precollege math, and students in advanced math courses gained relatively more than females, seniors, and students enrolled in other math courses and levels. In general, access to and experience with computers were unrelated to gain in computer literacy. However, asking for help from the teacher benefited female students, and access to a computer outside of school affected the scores of ninth- and tenth-grade female students.[3]

Those of us who are responsible for implementing computer programs must be conscious of the affirmative action implications of such programs. The social consequences of preparing a tiny male technological elite to provide leadership are ominous and foreboding. Now that we have passed through the initial states of computer enthusiasm, serious issues need to be addressed.

Cynthia Bakon is Teacher/Computer Literacy, Antonia Nielsen is High School Computer Coordinator, and Jamieson McKenzie is Assistant Superintendent, all with the Princeton Regional Schools, Princeton, New Jersey.

[1]Joan Skolnick and others, *How to Encourage Girls in Math and Science* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1982), p. 3.

[2]Nancy Kreinberg, and Elizabeth K. Stage, "Equals in Computer Technology," in *The Technological Woman: Interfacing with Tomorrow*, ed. J. Zimmerman (New York: Praeger, 1983), p. 253.

[3]M. E. Lockheed, A. Nielsen, and M. K. Stone, "Some Determinants of Microcomputer Literacy in High School Students: Pilot Study," paper presented at AERA, Montreal, 1983.

EDUCATIONAL LEADERSHIP
September 1983

Equity in Computer Education

Microcomputers are widening the gap between rich schools and poor ones.

JOHN P. LIPKIN

The educational advantages and potential economic benefits to be gained from acquiring a knowledge of computers and how to use them render the question of equity in computer-based education a matter of paramount significance.

Computer literacy, broadly defined as the ability to use the computer as an aid to problem solving in all spheres of human activity, as appropriate, can greatly benefit the individual and the society. But it also represents the basis for creating a further schism between the "haves" and the "have nots." One of the outstanding implications of the new information technology is that poor people are the last to receive its benefits,[1] and those who lack the prerequisite skills of reading, writing, and computation are handicapped in attaining computer literacy. Thus, the economically and educationally disadvantaged are prime candidates to join the ranks of this new category of disadvantaged—the computer nonliterate.

To date, it would appear that public schools have unwittingly served to reinforce the advantages of the affluent in achieving computer literacy. Evidence that school microcomputer use is associated with the wealth of the school district first appeared in 1981, as the result of a survey undertaken by Market Data Retrieval (MDR). Nearly 30 percent of school districts where less than 5 percent of the population was below the poverty level used microcomputers for instructional purposes, MDR reported. In contrast, only 12 percent of the districts with over 25 percent of the population below the poverty level reported microcomputer ownership.[2] A follow-up survey conducted by MDR in 1982 found that 80 percent of the nation's 2,000 largest, richest high schools used microcomputers, while only 40 percent of the smaller, poorer high schools had them.[3] A separate survey undertaken by the Johns Hopkins Center for Social Organization of Schools during 1982–83 found that two-thirds of the public schools in the better-off districts had microcomputers, compared to 41 percent in the least wealthy areas.

The Johns Hopkins survey also found that schools that already owned microcomputers were more likely to buy additional ones than schools without any were to buy one for the first time.[4] This finding may be of greater consequence than the ownership gap between rich and poor schools, for it means that, contrary to popular belief, the poor schools are not catching up: growth does not mean equity. In fact, the wealthier schools are increasing their advantage over the poorer ones.

The most important equity questions are how microcomputers are used in the school and who receives the benefits. In this regard, Daniel Watt has pointed out that: "When computers are introduced into suburban schools, it is often in the context of computer programming and computer awareness courses. In less affluent, rural or inner-city schools, computer use is more likely to be in the context of computer-assisted instruction of the drill and practice variety. Affluent students are thus learning to tell the computer what to do while less affluent students are learning to do what the computer tells them."[5]

Because blacks, Hispanics, and certain other minorities are disproportionately represented in the inner city and among the poor, it can be assumed that students from these groups receive less than their fair share of computer instruction in general, and that they participate less in the higher level uses of computers in particular.

The rapid growth of microcomputer use in the majority of the nation's public schools is a tribute to the ingenuity, innovativeness, and hard work of both educators and the public that has provided support for their efforts. But if the benefits of the computer are to be provided to all students on an equitable basis, a major departure from present practice is required. Closing the gap will take additional funding and the development of resources—including skilled teachers and appropriate quality software.

Finally, it should be recognized that the attainment of equity in microcomputer education is only one aspect—albeit a major one—of the broader need for reform to bring about an appropriate, quality education for today's technological society.□

John P. Lipkin, formerly Professor of Education, McGill University, Montreal, Canada, is an education consultant, Washington, D.C.

1 K. Lenk, "Information Technology and Society," in *Microelectronics and Society*, ed. G. Friedrichs and A. Schaff (New York: Pergamon Press, 1982), pp. 273–310.

2 "Identifying and Getting Your Share of the School Market for Computers" (Market Data Retrieval, 1981).

3 *The Washington Post*, April 17, 1983.

4 Center for Social Organization of Schools, *School Uses of Microcomputers: Reports from a National Survey* (Baltimore: Johns Hopkins University, 1983).

5 D. Watt, "Education for Citizenship in a Computer-Based Society," in *Computer Literacy*, ed. R. Seidel, R. Anderson, and B. Hunter (New York: Academic Press, 1982), p. 59.

Computers Give Poor Kids New Disadvantage

... Schools around the nation are beginning to realize that in the information society, the two required languages will be English and computer.

—John Naisbitt, "Megatrends"

By Vivian Aplin-Brownlee
Washington Post Staff Writer

In the headlong national race to computerize classrooms, a complex high-technology version of an ageless social problem is emerging: Poor kids are being left behind.

The number of microcomputers in U.S. public schools tripled last year. It is expected to reach 500,000 by next June and surge to 2 million by June 1988. A University of Minnesota study projects that 85 percent of the nation's school districts will have computers available to pupils this year, up from 58 percent last year.

But the Minnesota study, done for the National Science Foundation, said youngsters in the nation's 12,000 most affluent school districts are four times more likely than students in the 12,000 poorest districts to have access to a computer.

The Johns Hopkins University Center for Social Organization of Schools reported in [illegible] that "whereas two-thirds of public schools in the better-off districts have microcomputers, only 41 percent of the schools in the least wealthy districts have any."

Sociologist Ronald E. Anderson, director of the University of Minnesota's Center for Social Research, said, "To the extent computer literacy and computer expertise are necessary for success in getting and keeping jobs, computer inequity is a serious problem. It threatens to separate groups and communities by giving some people more effective tools for living in the computer age."

The congressional Office of Technology Assessment issued a similiar warning last fall, stating that "if the technologies are primarily designed for and made available to middle-class families, they could increase rather than diminish the gap between the educationally advantaged and disadvantaged."

Alvin Toffler, author of "Future Shock" and "The Third Wave," wrote last year that "kids who know how to use them [computers] will have an edge over those who don't, and this [illegible] that, unless conscious steps are taken, white middle-class children will start out, once more, with an edge that the less affluent lack."

The problem is not just the availability of computers, but how they tend to be used.

Commenting on the remedial drill-and-practice that tends to be done on computers in poorer schools as opposed to program writing and problem-solving in more affluent schools, Ruth Cossey of the University of California's Lawrence Hall of Science said, "One group tells the computer what to do; the other sees it as a taskmaster. The group that has the power will get ahead."

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THE WASHINGTON POST
September 12, 1983

Computers Give Poor New Handicap

GAP, From A1

And some educators see still a third problem—partly remediable, and having to do with equity—with the rush to computerize. They say computers are impeding the back-to-basics movement.

As A. Daniel Peck, education professor at San Francisco State University and founder of the Committee of Basic Skills Education, said:

"We're in a computer religion explosion to the detriment of basic-skills education . . . the best we can hope for is some degree of sanity."

Minnesota has distinguished itself in the fight against institutionalized inequity. As the result of a state-wide commitment, 63.4 percent of its schools last year had at least one microcomputer, the small personal computer commonly used in homes and offices.

The Minnesota Educational Computer Consortium, a nonprofit, state-run organization, guides the state's efforts and designs its own software, or course material. It is widely considered a model for educators.

Executive Director Kenneth Brumbaugh estimates that a million copies of its materials are distributed each year to education systems, not only in the United States but in countries as diverse as Kenya, Australia and Saudi Arabia.

The socio-economic differences between wealthy and poor schools are illustrated in how they obtain microcomputers. Poor schools must usually depend on the district's revenues or the largesse of computer companies' donations, which some observers speculate are less likely to go to poor schools because they do not represent as rich a potential market for subsequent purchases, by schools or parents, as wealthier districts.

More affluent districts tend to have richer budgets for buying computers, are thought to be more attractive to corporations in the selection of gift sites and can rely on parents, community associations and teacher-parent organizations to make contributions.

But while computer equity might be the crux of the problem, keeping up with the computer explosion while staying focused on basics is no less troublesome to educators.

Teachers who are slow to adjust to the computer keyboard are another factor in the computer equation. They run the risk of being less effective in the electronic classroom than they are in traditional ones.

Educators are entangled in an electronic thicket. The computer, hailed as an electronic wizard honing the abstract reasoning skills of a new generation of problem solvers, is unfamiliar and even frightening to some teachers who view it as a disrupter of proven conventional methods.

But faced with legions of anxious parents, teachers and administrators find themselves hard-pressed to resist computers.

Critics complain that the current emphasis placed on putting computers in the hands of American children is driving educators to distraction, not only from teaching basic skills, but as they try to become comfortable with the machines.

Computer anxiety, a fairly common adult malady outside the teaching profession as well, ranks high on the list of distractions. "High Technology" magazine reported last spring that "Although teachers' colleges are gearing up as fast as they can to produce computer-literate teachers, this won't affect schools for years.

"Most teachers have found themselves totally unequipped to teach about or with computers and are scrambling to catch up with their computer-wise students."

Some teachers are blaming their school systems for exacerbating the problem. At the National Educational Computing Conference in June, "Technology Illustrated" magazine reported, some teachers "complained of school systems that spent thousands of dollars on mirocomputers but provided no training and no software, with the predictable result that teachers became hostile to the computers and refused to use them."

The National Education Association took a comprehensive look at computers in its members' classrooms in June. "In just a year or two," NEA Today reported, "the whole picture has changed. Few teachers still assert that computers are just another passing fad in education . . . ."

Those teachers who have become proficient using computers have become big fans of them. "In fact," the NEA reported, "a very common complaint has become, 'We don't have enough of them.'

"A 1982 NEA survey showed that 70 percent of teachers who reported computers' effects on students said the machines improve interest, motivation, attention span, self-confidence and cognitive learning. Half the teachers surveyed said computer learning would become common and be considered basic."

To help, the NEA is starting a computer service this fall to offer computers, their accessories and software at discount prices to members and to provide exact descriptions of how it all works.

Clearly the highly touted man-made wonders are creating as many problems as they are solving in education. Educators, having decided that computers are the answer, now want to work out the solutions for themselves.

"Where will it end?" NEA Today asked in June. "Nobody knows. But in school—as in industry and daily life—computer use is clearly taking root and growing fast.

"Teachers are not about to leave to others the important decisions about that growth—how to use computers, and how to offer all students the benefits of that use."

B. Seeking Educational Equity In An Information Society

This section developed by Shirley McCune, Vice President, The Naisbitt Group, presents an overall context for planning equitable educational programs in an information society. It includes the following subsections:

PREFACE

1983 may be called the year of the awakening of the educational community. There is a growing consensus that our society is in a profound transformation process of moving from an industrial to an information society. This restructuring of our society gives us cause for optimism and concern.

Every society must deal with the fundamental issues of how roles and resources are to be assigned and allocated. In the past, education and training played a major role in the "sorting" of individuals and groups for the industrial society. Today, this sorting process is no longer functional and we must begin to consider education and training systems in new ways.

Our rethinking of education and training must be based on four sets of considerations:

- a critical resource in an information society is productive education and training systems and such systems are essential for economic growth and development;
- just as economic institutions are being restructured to meet the needs of an information society, so must education and training systems be restructured to meet the changed conditions of the society;
- educational equity in a society as diverse as the United States is not only a desirable value but also a necessity for our national ability to compete in a global economy;
- opportunities for restructuring are most likely during times of societal change; the next few years are crucial as they provide the "windows of opportunities" for change and improvement.

Although there is an increasing awareness of the needs for restructuring and the windows of opportunity, there is a temptation to "wait and see" when we have gained a more complete understanding of the changes in the society. Actions must be based on available data and understandings, but we cannot allow ourselves to "drift" into even more difficult situations.

All of us must immerse ourselves in gaining an understanding of trends and changes in our society; the delineation of their implications for education and training; and the design of action steps which can maintain and extend existing levels of equal opportunity and the continued progress toward the goals of quality education for all students.

The purposes of the following materials are in keeping with this task. They provide information on:

- an economic context for education;
- the societal context for educational change;
- directions for restructuring and improving education:
- achieving school improvement through the use of technology; and
- developing a strategic plan for change.

The materials are designed to provide information, stimulus questions and background information for your consideration. They are not designed to be comprehensive or "finished" and they will be revised in the future. Any suggestions you have for additions, revisions or deletions would be appreciated. Suggestions should be sent to:

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This section was developed by Shirley D. McCune for inclusion in the notebook.

I. An Economic Context for Education

There is general agreement that one of the critical issues facing the United States today is the maintenance and renewal of an economic system which can meet the needs of the American people. The United States, long a leader in world productivity and the establishment of a high standard of living, is now confronted with four major structural changes in our economic system:

- After more than three decades of rapid technological growth and innovation, the United States economic system has been dramatically restructured from an industrial economy based largely on manufacturing, to an information economy based largely on service and information activities;

- The United States economic system has become part of a global economic system and our future is inextricably bound with the economic systems or other nations;

- United States productivity and growth has declined over the past 15 years and other countries are closing the gap between their productivity rates and U.S. productivity;

- Our future economic and social well-being will depend, in large measure, on our ability to continue to provide the "cutting edge" technology for the rest of the world and demonstrate the ability to move a product quickly into production and go on to the next generation of products.

If the United States is to respond to the urgency of these changed conditions, it will require an economic renewal program of a magnitude seldom seen in U.S. history. Such an economic renewal program must be built on a competitive strategy which will enable U.S. business and industry to provide high-quality products at prices which are equal to or better than other world producers. This is increasingly difficult in that other countries can exploit their resources of raw materials, cheap labor, or available capital in any form of competition.

The primary resource which the United States must rely on is a basic increase in productivity, that is, the ability to use technology to create more in less time and the ability to develop new processes, products and knowledge. United States workers must demonstrate the ability to work smarter, faster and better than other nation's workers.

Perhaps the central need for designing any program of national economic renewal is the need to develop competitive strategies or plans which can deal with the complex issues in any successful renewal program. A competitive strategy for economic renewal must confront the need for increasing our international markets, for continued and expanded technological research ard development, for the retooling of a decaying industrial plant, and for increased productivity.

A central strategy for each of these needs is to increase the performance of American's workforce. A critical resource and component of any economic renewal plan is our education and training systems and their ability to provide the workers who can work smarter, faster and better. Increased involvement in technological applications requires a work force capable of dealing with more sophisticated machines and equipment -- a workforce that is capable of problem solving and collaboration. It also requires a workforce that is capable of understanding and using technology and participating in decision making which requires a basic scientific and technological literacy.

In short, education and training become central activities for economic development. High quality education and training systems are not a luxury in our global, information society; they are a <u>necessity</u> for being able to compete with other nations for world markets and maintaining our standard of living.

Just as there is need for restructuring of the economic system, there is also need for the restructuring of education and training systems. The ultimate outcome or mission of improving and restructuring our education and training systems includes:

- significantly increasing the pool of highly trained mathematicians, scientists, engineers and computer scientists needed to advance technology and technological applications essential for economic growth;

- significantly increasing the general levels of knowledge and skills of the total population which can increase productivity in all areas, provide a sufficient supply of technicians for high-technology activities; and prepare a population capable of consuming information-related services;

- extending our capabilities for lifelong training and for the retraining of groups within our population whose jobs are gone; and

- raising the levels of human capability and productivity (human capital) in ways that maintain and extend equal opportunity and access for all groups within the population.

Achieving this level of restructuring will require the involvement of all areas of education -- postsecondary education, training systems, vocational education and community education programs. The basic building block for a restructuring program begins with public elementary and secondary education systems. Their success is essential to extend the goals and achievements of education at other levels.

The restructuring of public elementary and secondary education programs requires a national commitment and the active involvement of leaders at state, local and national levels. The restructuring requires:

- establishing goals, directions and expectations for educational achievement and mastery of knowledge and skills;
- increasing the quality and quantity of time devoted to educational and learning activities through extension of the school day, the school year, and the more effective involvement or parents and community learning resources;
- encouraging academic excellence and achievement by measuring continuing individual mastery and improvement of skills rather than artificial time and age requirements;
- improving the quality and quantity of educational personnel through the attraction of capable persons into the education workforce, the continuing upgrading of knowledge and skills, and the measurement of effectiveness according to objective measure of student mastery and achievement;
- improving the management of education programs by increasing the skills of educational administrators, providing recognition and rewards for improved management, and utilizing exemplary management skills and processes currently used in business and industry;
- developing and implementing models which can involve business-industry, community institutions, mass media, computer networks and home instruction systems in more

systematic and collaborative efforts to improve learning;

- increasing the rewards and recognition for exemplary education service by providing additional pay, incentive pay for student achievement, developing "excellence recognition programs," and increasing the psychological and learning rewards of education careers;

- providing the financial resources, technical assistance and support systems necessary for the improvement of education systems.

The task of bringing about the necessary changes in education at the levels needed for economic renewal is not easy. It will require dedicated leadership at state, local and national levels which is aware of the needs and committed to finding those solutions which are in keeping with the diverse state and local responsibilities for the provision of education. And it will require a continuing attention to the monitoring of equal access and the correction of identified problems.

II. The Societal Context for Educational Change

The need for some examination of the societal context for change begins with a restatement of the basic, paradoxical functions of education in any society. Education must:

- maintain the knowledge and experience of the past and transmit it to the youth as a means of their basic preparation for adult roles -- in this sense education is a conserving or conservative institution;

- anticipate the future and design select knowledge, experiences and skills which will be essential to youth's participation in a future society -- in this sense education provides a means to facilitate social change.

Education programs always reflect the values and the goals of a society. The fact that our society produces 1,000 lawyers for every 100 engineers and that Japan produces 1,000 engineers for every 100 lawyers suggests a difference in orientation and values between the two societies. Educators must understand the larger social context and values if they are to be effective in preparing students for full participation in society. Knowledge of this context is essential even when your goal is to change the emphasis and values of the larger society.

The formulation provided in John Naisbitt's book, Megatrends: Ten New Directions Transforming our Lives, and the extension of this data base contained in the Trend Report provides us one way of thinking about the larger societal context and the implications for education. John Naisbitt's observation that it is easier to ride a horse in the direction it is already going is useful as we begin to examine the needs for change and the strategies which might be pursued as we work to restructure and improve education.

Some of the "megatrends" or consistent changes which are evident across the various sectors of the society are:

1. Our society is moving from an industrial to an information society.

   Economist Marc Porat indicates that the United States ceased being an industrial economy and became an information economy in 1963, when 53 percent of the gross national earnings were reported to be in the information sector. Another indication of this trend is found in the employment of our workforce. In 1950, 55 percent of the paid workforce was employed in industry; today only about 18 percent are employed in industry. By contract, 28 percent were employed in service and information jobs in 1950 and today more than 56 percent are employed in these sectors.

This shift in the nature of available jobs raises issues as to emphasis of elementary and secondary education programs as well as the context, enrollments, and support of post-secondary, vocational and continuing education programs. Many have suggested that the importance of basic skils is increased and there is need for developing new levels of the higher order skills of analysis, synthesis, problem solving and creativity.

2. Our society is moving from a centralized to a decentralized society.

Two primary events -- the Great Depression and World War II -- served as major stimuli for the centralization of our society. The move in a centralized society was toward big business, big government, big unions and a vertical type of organization. During recent years this trend was reversed and decentralization can be seen in the New Federalism proposals, the emphasis of block grants and a general trend to solve problems across state or local levels (horizontal structure).

Within education, this trend is evident in the increasing importance of the role of state and local governments. It can likewise be seen in the shift in emphasis from using the district as a unit of analysis to using the individual school as a unit of analysis. Greater attention has been focussed on the school principal as a key educational leader.

3. Our society is moving from a national economy to a global economy.

The isolation that once characterized American foreign policy at the turn of the century is clearly a phenomenon of the past. Today, the condition of our economy depends in large measure on ability to provide goods and services to other countries throughout the world. What happens in Central America, Iran, China, Japan and Russia and any country of the world can have a profound effect on our economic well-being and the ways we organize our lives.

In general, American education has not considered the need to prepare students for being a citizen of global village as a priority activity. In fact, bilingual education is, in large measure, considered a deficit for students rather than an asset which can be used in productive ways. There is a similar lack of emphasis on understanding the cultures of other countries around the world. These needs are likely to lead to an increased emphasis on foreign languages and the extension of global education activities and programs.

4. <u>Our society is moving simultaneously toward high technology and toward "high touch".</u>

When technology is not accompanied by a compensating "high touch" aspect (those activities which contain strong elements of human response), the technology is likely to be rejected. The compensating response to the high technology of television was group therapy and the human potential movement. CB radios and "walkie talkie" systems became a national craze and they have been incorporated into our daily lives because they provide ways for many to maintain communications with other people.

This trend is evident in education in the acceptance of microcomputers. Computer-assisted instruction using mainframe or minicomputers has been demonstrated but it is not widely used because it was difficult for students and teachers to have consistent "hands-on" experiences and utilize their full capacity. The introduction of arcade games and the home computer have changed the picture dramatically.

Microcomputers are becoming an essential component of education programs and schools are under pressure to acquire them and use them for instructional, administrative and general information processes.

5. <u>Our society is moving from an either/or to a society of multiple options.</u>

At one point in time the choices in education were largely either/or. You were involved in academic programs or vocational programs; in private schools or public schools, in K-12 education or postsecondary education. Today, the lines are blurring and more options are being provided for citizens. Community colleges are one example of the trend to meet a variety of needs and to continue one's options for education.

Elementary and secondary education programs were typically designed to provide a consistent program for all students in the district. While some options were provided in secondary schools, the choices were comparatively limited. Today we see the magnet schools, alternative schools, and enrichment programs as examples of efforts to provide multiple options for students within the educational system. There are magnet or alternative schools for basic skills, for science and mathematics, for performing arts, for language studies, for gifted programs, etc. These are part of a continuing effort to serve the range of values and needs found in nearly every community.

6. Our society is moving from a pattern of institutional help to self-help.

A characteristic of our centralized, industrial society was the trend of looking to institutions to meet individual and societal needs. This trend was reversed as evidenced in the wellness movement, the increased use of barter, cooperative living arrangements and self-help networks.

This trend is evident in education by the rapid expansion of the use of home computers for learning and educational purposes, the expectations that individuals must fund a greater proportion of their learning costs, and the expansion of school fees.

Other trends which the Naisbitt group have identified include:

From	To
North	South
Business as usual	Accountability
Hierarchies	Networking
Economies of scale	Appropriate scale
Managerial society	Entrepreneurial society
Representative democracy	Participative democracy
Family as basic unit	Individual as basic unit
Party politics	Issue politics
Machismo society	Androgynous society

Perhaps the most important things to remember about the changes in our society are the differences between the three types of societies--the agricultural, industrial and informational societies. The following diagram illustrates some of the key differences.

	Agricultural	Industrial	Information
Strategic Resource	Land Raw Materials	Capital	Data Information
Transforming Resource	Physical Man	Processed Energy	Conceptual Space Knowledge
Time Orientation	Past	Present	Future

It is important to note the critical importance of data and knowledge or the ability to apply information. Similarly, education and training assume greater importance because they have greater importance for all sectors of society.

These megatrends establish a context which impacts education. Planning should be guided by Naisbitt's comment that "it is easier to ride a horse in the direction that it is already going." These trends provide a starting point for examining the needs for the restructuring of education programs, policies and practices. Our tasks must be to anticipate the likely impact of these trends on education, develop strategies for utilizing or counteracting their impact and developing action efforts which can lead to positive outcomes.

STIMULUS QUESTIONS

1. What are some of the examples of the megatrends which you have observed in education? What examples of counter-trends have you identified?

2. What have been the responses to these trends in your state?

   in your district?

3. What changes are needed in your state to support restructuring of education programs?

4. What changes are needed in your district to support the restructuring of education programs?

5. Where would you place the priorities for action in your district?

III. Restructuring and Improving Education

Any discussion of the implications of the megatrends for educational programs requires a comparison of the current characteristics of education with a vision of what types of educational programs would be needed in the future. One way to make this analysis is to identify possible changes in the goals for education, the delivery systems for education programs, the financing of education programs, the training of educational personnel, assessment and evaluation systems and community outreach programs. The following chart is provided as a beginning point for stimulating your thinking as to the probable areas of change for education. It is important to understand that the movement from an industrial to an information society does not imply an either/or type of choice, but rather that the items included in the information society lists are extensions of the past and a change in emphasis rather than an abandonment of the past.

PROBABLE CHANGES OF EDUCATIONAL EMPHASIS

Area	Industrial Society	Information Society
Goals of Education		
Cognitive Goals	Basic skills Specific training Right to read Unicultural Literacy as survival skill	Stronger higher order skills Generalizable skills Right to excel Global education Many literacies, more than one language
Affective Goals	Large organization skills Organization dependent Single family orientation	Small group skills Independent entrepreneurial Support group orientation
Educational Personnel	Teacher as subject matter expert	Teacher helps students get and use information
	Teacher as standards setter	Teacher as self-concept developer
	Principal as middle manager for central office	Principal as manager, curriculum leader, staff developer and neighborhood contact
	Superintendent as professional educator	Superintendent as politician and integrated community leader with specialized education expertise
	Superintendent as status quo leader	Superintendent as educational leader and community resource developer

Area	Industrial Society	Information Society
Assessment and Evaluation	Diffused routine accountability/ assessment	Achievement/performance accountability
	Teacher/administrator performance measured by judgment	Data-based performance measures
	Periodic assessment	Ongoing assessment for educational diagnosis
	Teacher/administrator performance used as baseline standards	Teacher/administrator performance used for incentive pay
Community Relationships	Parent as passive consumer	Parent as participant consumer/decision maker
	School district youth oriented	School district lifelong learning oriented
	School as isolated educational institute	School as community service institution
	Distinct subject matter areas	Synergistic study areas
	Student as passive recipient	Student as integral part in school community
Curriculum Areas	General, diversified	Science and math emphasis
	Print oriented	Computer literacy
	Physical education	Physical/mental well-being
Job Preparation	Single-career preparation	Multiple-career preparation
	Late skill development	Early skill development
	Distinct vocational education programs	Career/vocational education as integral part of educational community experience
Financing of Education	Institutional financed	User financed
	Public sector	Public/private sector collaboration
Delivery Systems	Total district system	Neighborhood models
	Central office oriented	School-based management
	Superintendent focused	Principal focused
	Formal board-community leadership	Informal parent-neighborhood leadership
	Business as a consumer of school output	Business as a participant
	Group instruction	Individualized programs
	District structure/ standards	Neighborhood variations
	Standardized programs	Multiple option programs

THINGS TO THINK ABOUT

The above chart is simply a beginning formulation of identifying possible implications of changes in our society. What things do you feel have been omitted, should be modified, or should be eliminated from each of the categories provided?

Goals of education

Delivery systems for education

Financing of education

Training of educational personnel

Assessment and evaluation systems

Outreach programs

How would you apply this formulation to schools in your district?

IV. Improving Educational Programs

The improvement of educational programs begins with some formulation of quality education and the goals and objectives which would support the attainment of quality education programs. There are many ways to describe quality education. The listing provided below is a preliminary formulation of the critical components of quality education.

Quality education should provide all students with:

- A high level of proficiency in the basic skills including:
  - The ability to read and comprehend written material
  - The ability to understand mathematical concepts and to carry out mathematical computations
  - The ability to understand scientific concepts and their relationship to the work and activities of our society
  - The ability to speak and interact with others in a variety of situations
  - An understanding of computer applications and the skills of interacting with computers
- An opportunity to develop higher order skills including:
  - The ability to synthesize, generalize and apply information
  - The ability to search, retrieve and utilize information and data (learning to learn)
  - The ability to diagnose situations and to solve problems
- A strong sense of self-concept and knowledge of personal strengths and abilities
- An understanding of other nations, cultures, their languages and contributions to the global community
- An understanding of the world of work and a beginning level of career/vocational preparation and work skills

After reading through this statement of quality education, what additions, deletions or other changes would you make for your description of quality education?

improvement programs begin with some understanding of what "works" in education. The National Institute of Education has devoted considerable effort in recent years to conduct studies which examine the characteristics of effective schools, effective administration and management and effective teaching. Some of the results of these studies are summarized below.

The findings of this research may be grouped into two areas -- research and the teaching/learning process and research on the structure and management of schools. With respect to the first area, some of the findings are outlined below:

1. The amount of time devoted to academic learning varied widely. Effective teachers were able to allocate more time for instruction, were able to engage students in learning tasks, and engage them when they were performing at high success rates (allocated time, engaged time, and academic learning time).

2. The organization, planning and scheduling of activities were essential to effective classroom management. Efforts to devote time to advanced planning and preparation before the school year began, to train students into a routine of activities at the beginning of the year, and to facilitate effective group relationships among heterogenous students all contributed to effective classroom management.

3. In general, structured programs were more successful than individualized or discovery programs. Effective teachers were able to:

   - structure learning experiences
   - proceed in small steps but at a rapid pace
   - give detailed and redundant instructions and explanations
   - use a high frequency of questions and overt, active practice
   - provide feedback and corrections, especially at initial stages of learning
   - have a student success rate of 80 percent or higher on initial learning tasks
   - divide seat-work assignments into smaller segments or devise ways for frequent individual monitoring of students
   - provide for continued student practice (over-learning) so that students have a high success rate and become confident, rapid and firm in their learning

Some of the findings of the improvement literature which are related to the structure and management of effective schools include:

1. There is a strong administrative leadership, usually the principal, especially in regard to instructional goals and outcomes.

2. There is a clear school-wide emphasis on basic skills which is agreed to by all members of the staff.

3. Teachers expect that students can reach high levels of achievement and their behaviors communicate this expectation.

4. There is a system for monitoring and assessing pupil performance which is tied to the instructional objectives.

5. The school climate is conducive to learning in that there is safety, order and discipline.

When we understand the factors which account for success at the local level, we must then engage ourselves in the process of "backward mapping" or identifying the state policies and programs which can support the development, maintenance, or extension of the effective proactives. It is this process which requires not only in-depth knowledge of curriculum and the structure of local programs but also the policy making and policy implementation processes of states.

STIMULUS QUESTIONS

1. What directions or trends for restructuring would you add or subtract from the listing provided:

    - The goals of education?
    - The financing of education?
    - The delivery of educational services?
    - The training and retraining of educational personnel?
    - Assessment and evaluation programs?
    - Special programs, facilities?
    - The governance, outreach and community involvement?

2. What are the likely equity issues in each of the areas?

3. What steps can be taken at the state level to reduce/overcome the source of the equity issues?

4. What steps can be taken at the state level to support school improvement efforts?

5. What steps can be taken at the district/local level to reduce/overcome the source of equity issues?

6. What steps can be taken at the district/local level to support school improvement efforts?

V. Achieving School Improvement Through the Use of Technology

Given the need for improving schools it is important that we begin to use the technologies which are available for the improvement of learning. One of the most versatile technologies which is now available to us is the microcomputer. Since the introduction of microcomputers in schools in 1979, their availability in schools has increased dramatically. It is estimated that 400,000 microcomputers will be in schools by the end of the 1982-83 school year.

The introduction of microcomputers in schools creates the need for a new understanding of their uses, the management of their use, and the likely problems which may result from their use. The following section outlines some of the considerations and questions which should be addressed in the use of computers in schools.

Computer Uses

School personnel frequently begin to plan their approaches for using computers by looking at computer hardware. Important as the questions of what to buy are, the answers must begin with an understanding of the purposes for using the computers. Listed below are some of the ways which computers may be used in schools and the programs which may be designed.

Strategic Use #1--Computer and Computing Literacy

One of the most common uses of microcomputers in schools may be called computer and/or computing literacy. This use of microcomputers begins with the realization that computers are an integral part of our society and every citizen needs some understanding of computers and how they work. There are many definitions of computer literacy but most of these include an understanding of what a computer is (knowledge), how it works (mechanical use), how to use it, how to make it work for a specific application.

Instructional objectives may be developed for any level of performance. Some of the understandings which should be developed in computer literacy courses are:

- What is a computer?

  The student should be able to identify a microcomputer and the types, speeds and sizes of available microcomputers. Some understanding of the past and future evolution of the microcomputer should be included.

- What are computer peripherals?

  The student should be able to distinguish the microprocessor from the peripherals that support its use: various input devices, storage procedures and methods, display devices, graphic equipment, control equipment and interactive equipment.

- What may a computer be used for?

  Students should understand the basic functions of the computer and how these may be applied. The functions of calculations, record-keeping, word-processing, simulation and gaming, control of other machines, retrieval of information, instruction, and the creative arts should be included in this understanding.

Once the decision has been made regarding the knowledge students should gain, a decision must be made as to the level of skills which should be developed in using the computer. Examples of some of the skills are:

- assemblying and connecting components for operation
- ability to turn on a computer, "boot" up an existing program, and responding to program commands
- ability to input data (what kinds of data? what levels of key boarding skill?)
- ability to output data to different peripherals (which ones?)
- ability to modify or develop new programs (what languages--LOGO, BASIC, PASCAL, Fortran, COBOL, machine language and at what level of proficiency?)

Decisions should include consideration of the grades where various content and skills objectives are to be achieved and the amounts of instruction and time which are needed to achieve these levels of proficiency.

Many have pointed out that ~~computer literacy~~ typically focuses on the study of machines and that this knowledge will become largely irrelevant because the technology is changing so rapidly. They point out that what is needed is computing literacy or the study of how machines may be used. Courses in computing literacy would place primary emphasis on the "tools" which computers provide for a variety of tasks. Examples of some of these tools or functions are:

- word processing
- calculating
- storing information
- retrieving information from computer networks (research)
- computer design and graphics
- programming for problem solving

Many of these tools are important aids for the development of higher order skills and the enrichment of the school curriculum.

Questions to Consider

1. What is your definition of computer literacy? of computing literacy?

2. What understandings and skills of computer and computing literacy would you include in your district's program? At what grade levels? At what levels of proficiency?

3. What priorities would you establish for the introduction of computer/computing literacy?

4. What additional information do you need to make these decisions?

Strategic Use #2--Educational Instruction

Computers have an increasingly important role to play in instruction. Some of the ways that computers may be used are:

Drill and Practice

The use of computers for student drill and practice. This use of the computer for mathematics instruction has been demonstrated as effective. Drill and practice may be used for increasing the efficiency of initial learning, for remediation of areas of need, and for content and skill enrichment.

Direct Instruction

The computer may be used as a tutor which presents information and interacts with students. They may be used in place of textbooks, workloads or the teacher for presenting new information. The effectiveness of this form of instruction is largely dependent on the quality of the software. It is important to note that some studies of drill and practice or direct instruction have used 20 minutes a day, four days a week as the minimum time if such instruction is to be effective.

Enrichment or Advancement

Some believe that the computer has special uses with gifted and talented students. It allows them to advance beyond the levels of their colleagues without taking significant amounts of time from the teacher. The effectiveness of this use relies, in part, on quality software and the provision of computers for individual, creative work.

Special Education

The computer and related peripherals are being used with special needs children. They provide instruction at their own pace and often give them a new sense of control and independence.

Questions to Consider

1. How should/are computers being used for instruction in your district?

2. At what grades would you use computers for instruction?

3. Where would you place priorities for use?

4. How would you deal with the potential problems of equity of access and participation for some groups of children?

Strategic Use #3--Infusion of Computers for Improving Instruction

Some believe that computer instruction should not be separated from regular instruction but should be an integral part of the instructional process. This would require having computers in the classroom and ready access for students.

Examples of some of the areas of infusion are:

- business classes integrate computers into typing, accounting, management courses, etc.
- mathematics classes integrate computers into a variety of math problem solving activities--solving complex equations, drafting geometric problems
- language arts classes integrate computers for the teaching of writing, spelling, vocabulary, etc.
- science departments integrate computers into research, experiments, simulations, and problem solving
- art departments integrate computers into the teaching of design and commercial graphics
- music departments integrate computers into study of theory, synthesized music, composition and conducting

Questions to Consider

1. What other uses may be made of the computer for infusion purposes?

2. Where would you place priorities for curriculum infusion?

Strategic Use #4--Vocational Preparation

Many schools are providing courses to prepare students with computer skills which are marketable in business and industry. Examples of these skills are:

- word processing
- computer programming
- computer-aided drafting
- computer design and printing
- computer repair
- robot design
- robot repair

Questions to Consider

1. What other examples can you identify?

2. What are the needs in your community?

3. Where would you place the priorities?

Strategic Use #5--Computer-Managed Instruction

Some believe that the best short-term use of the computer in the classroom is to assist in the management of instruction, rather than instruction per se. This approach assumes that it will be some time before a range of high quality software for all curriculum areas will be available and providing enough hardware for all students is beyond the available resources.

Computers may be used by the teacher for:

- diagnosing student needs
- prescribing individual programs
- scheduling individualized instruction
- monitoring student achievement
- testing results
- computing and recording grades
- reporting

Questions to be Considered

1. What other uses can the teacher make of a computer for improving instruction?

2. Where would you place priorities for your district?

Strategic Use #6--Administrative Uses of the Computer

Computers have been used for administrative purposes for some time. It is used extensively for personnel, payroll, budgeting, accounting, inventory management, bus routing, and class scheduling. Recently, other uses have been made of the computer such as:

- monitoring building use and energy use
- tracking individual student's progress
- keeping track of pullouts, immunizations, discipline problems, health records, etc.
- library cataloging and circulation

Questions to be Considered

1. What other administrative uses would you make of computers?

2. Where would you place the priorities?

VI. Strategic Planning: A Tool For Restructuring and Change

The need for planning programs which can chart a direction or course for the future is widely acknowledged as a need but seldom utilized by institutions or policy makers. Some of the most common barriers to traditional long-range planning efforts are:

- long-range planning is complicated and time consuming;
- planning frequently highlights or extends the gaps between planners and doers;
- frequent changes in governance, administrations and staff disrupt the process;
- budgets are seldom linked to program goals and plans.

These problems have led to the development of a modified planning process -- a process oriented to changes in the environment; a process which uses decision makers' judgements; and a process of continuing review and modification to fit changing needs and environments. The process, developed in business and industry, has potential for application in the public sector. Strategic planning is described by Baldridge as:

> "The central focus of strategic planning is developing a good fit between the organization's activities and the demands of surrounding environments. Strategic planning looks at the big picture: the long-range destiny of the institution, the competition between this organization and others in its environment, the market for organizational products and services, and the mix of internal resources to accomplish the organization's purposes."

The goal of strategic planning is focused on making wise decisions more than producing a set of plans. It emphasizes flexibility and a quick response to changes in the outside environment. It is more concerned with doing the right things than doing things right.*

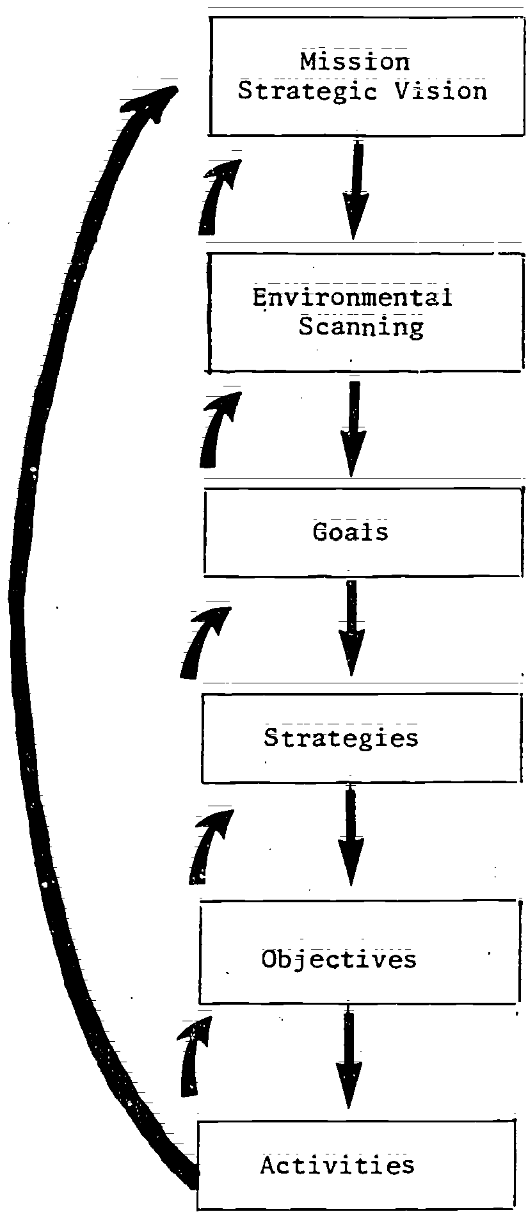
* For an expanded description of strategic planning see "Strategic Planning in Higher Education: New Tool or Gimmick" by J. Victor Baldridge and Patricia H. Okimi in AAHE Bulletin, October, 1982.

Strategic planning is usually carried out at the top levels of the organization and it is organized to answer questions such as "Where are we going?," "What business are we really in?," and "What is the future of the organization?" These questions are equally as important to state educational decision makers. Developing the answers to these questions provides a framework for developing operational, program, and tactical plans which are usually carried out at lower levels.

There are a variety of models for strategic planning which may be used but most use two key elements -- the development of a consensus as to a strategic vision of what is to be accomplished and a review of relevant available data known as environmental scanning. An example of a strategic vision was when President Kennedy articulated the vision of getting a man on the moon. Currently, Governor Robert Graham is articulating the strategic vision of moving achievement test scores of Florida students from 36th place to 3rd place in the nation.

Strategic planning is not linear and orderly but the following provides a visual outline of usual steps in strategic planning.

Strategic Planning Model



Strategic plans are usually prepared for a three- to five-year period of time but periodic evaluations and environmental scanning activities are used to review the plan and make any necessary modifications or additions.

It is important to remember that strategic planning is not the only type of planning that is necessary for achieving the improvement goals of a district. Strategic planning provides the framework and the structure of other types of planning. A listing of some of the forms of planning and the persons responsible for the implementation and monitoring of such plans is outlined below.

Levels of District Planning

Type of Planning	Groups	Outcomes	Ongoing Responsibilities
Strategic Planning and Management	Board Superintendent Key managers Representatives of teachers and staff at initial stage	Statement of goals, policies, budget allocations	Monitoring programs, policies and progress
Program Planning and Management (design of student programs, day-to-day management of programs)	Superintendent Key central office staff. Principals	Total district program. School programs Instructional guidelines. Management guidelines. Budget recommendations.	Administering and managing programs
Program Delivery (direct responsibility for delivery of quality program)	Principals Teachers Counselors Staff	Quality education programs	Continuing delivery and improvement of program
Student Program Planning (designing and achieving individual learning goals)	Teacher Counselors Students Parents	Optimal personal achievement and growth	Continuing establishment and achievement of individual learning goals

The next few pages are designed to help you think through the various processes of the strategic plan development. Questions have been used to help you think through the process, but the content of your strategic plan will depend on each of you.

Stimulus Questions

The development of a strategic plan begins with the forumulation of a strategic vision or goal which can serve as a motiviation for progress. The strategic vision may be limited, e.g. increasing the achievement scores of students in a state from X place to Y place or it may consist of a number of related goals. A beginning point for considering the strategic vision is to consider the outcomes of your vision for future education programs. The following questions are designed to help you identify a vision for your district.

Building a Strategic Vision

1. What is your strategic vision for education in your district?

2. How widely do you believe this vision would be shared among groups in your community?

3. How well does your vision serve the needs of all groups in your community?

4. Look back on your vision for education in your district. Does it

   - consider changing technologies--the potential impact and opportunities which it provides?

   - include social sciences and humanistic content as well as the physical sciences?

   - include the need for improved education for all groups in your district?

   - consider the language and cultural studies needed for global participation?

   - respond to trends and the context of the larger society?

5. In what ways, if any, would you modify the vision for your district?

Initiating an Environmental Scanning Process

The term "environmental scanning" was developed in response to the realization that change often happens so quickly that our best plans need to be revised. Sometimes there will be a need for extensive revision of the plan or it may simply identify the need for minor changes. Usually four sets of environmental factors are examined--demographic factors, economic factors, social/political factors, and educational factors. Preliminary sets of questions which can guide your environmental scanning are given below.

Demographic Factors

1. What has been the pattern of school enrollments in your district and what is your best estimate of future enrollments?

2. What are the enrollments by grade levels and what is the percentage of the drop-out rates?

3. What are the numbers of students in special programs (handicapped, compensatory education, bilingual education, gifted and talented, vocational programs, etc.)?

4. What is the racial/ethnic composition of the students in the district?

5. What are the numbers of female and male students by grade?

6. Are there disproportionate assignments of students to schools or programs by race, ethnic group or sex?

7. What are the characteristics of parents in your community? (socio-economic groups, religious groups, single parents, etc.)

8. What groups do you believe are best served by the schools? What groups do you believe are least well served by the schools?

9. What other demographic characteristics can you identify that are relevant to education programs in your district?

10. What changes, if any, do you anticipate in the demographics?

Economic Factors

1. What is the general fiscal condition of the district?

2. What fiscal problems or windfalls do you expect in the future?

3. What programs or activities have been best funded? What programs or activities have been least well-funded?

4. How would you describe the general community support of schools and their willingness to provide resources for the schools?

5. What other economic factors are likely to affect the district schools?

Socio/Political Factors

1. How would you describe the general political support of district schools?

2. What do you think are the general community perceptions of the district schools?

3. What types of activities or improvements would the community be most likely to support?

4. What organizations, businesses, industries, leaders, etc. have provided support to the schools and how would you go about increasing this support?

5. What other factors could you identify which affect the socio-political climate of the community and which have relevance for education programs?

Educational Factors

Educational programs include students, curriculum and staff. Most improvement efforts deal with each of three but many emphasize one as a starting point. Some assessment of the current status of each needs to be made before a plan is developed. How would you rate the strengths and weaknesses of each of the following?

	Strengths	Weaknesses
Student Achievement		
Student Curriculum		
Teaching Staff		
Management Staff		
Support Staff		

We can spend a great deal of time expanding the data we have in each of the areas. This needs to be started and reviewed with all persons participating in the development of the strategic plan. At this time we have moved through the first two steps of the strategic planning model and we have parts of the situation audit.

C. Instructional Uses of the Computer

This chapter provides information for educational administrators and teachers to help them keep up with an improving technology. It includes the following resources:

INSTRUCTIONAL USES OF THE COMPUTER: AN OVERVIEW

We can divide the many instructional uses of computers into three categories: (I) the computer as a subject to be taught, (II) the computer as a teacher, (III) the computer as a management tool.

I. Computers as a subject to be taught

- COMPUTER AWARENESS AND COMPUTER LITERACY: Teaching students how computers work, how to use one or more computer program languages, how to interpret computer programs and computer output and how to input the computer.

- COMPUTER PROGRAMMING: Having students learn to program computers to solve problems. Providing students with programming instruction so that they will be able to apply their knowledge and skills to maximize the computer as a resource.

II. The computer as a teacher

- TUTORIAL DIALOGUE: Using computers to present information to students, diagnose student performance and provide additional information, remedial instruction and individually-designed practice based on previous responses.

- DRILL-AND-PRACTICE: Using computers for student practice of skills whose principles are taught either by the computer (tutorial dialogue) or by the teacher in traditional ways.

- BUILDING INFORMATION AND RESEARCH SKILLS: Using computers as a writing pad, calculator, dictaphone, thesaurus, and reference library to access and use large data banks of information. Using computers to teach such skills as typing and editing, as well as developing expository skills, information retrieval skills, and research skills.

- SIMULATION, MODEL-BUILDING, AND GAMING: Using computer programs to demonstrate the consequences of a system of assumptions, or the consequences of varying an assumption, providing simulated "environments" with which students can investigate areas of mathematics, social sciences, ecology, physics, etc. Using computer games, simulation and model building to teach logical thinking and to provide the students with insights into things which ordinarily would be beyond their experience.

- COMPUTER PROGRAMMING: Using computer programming to develop cognitive abilities in problem solving, logical thought and abstract reasoning. Construction of computer programs can bring insight into specific aspects of subjects being investigated. Programming develops a student's ability to formulate specific steps in problem solving.

II. The computer as a management tool

- MANAGEMENT OF INSTRUCTION: Using computers to maintain and report individual student performances, skill levels, and records of student progress. Can be used with regular instruction or computer-assisted instruction.

- MANAGEMENT TOOL: Using the computer to assist in the administration of schools through the use of statistical packages, accounting and mailing systems, word processing, maintenance of data bases, and communication networks.

eveloped by Sheryl Denbo, Director, Mid-Atlantic Center for Race Equity

INSTRUCTIONAL USES OF THE COMPUTER: A REVIEW OF THE RESEARCH*

The relative effectiveness of microcomputers in educational settings is still being debated. Most of the research on computer-assisted instruction (CAI) has indicated that it is at least as effective as traditional education and, as an educational supplement, it generally improves student achievement. Unfortunately, current research on CAI has for the most part been limited to an examination of tutorial dialogues and drill and practice and has often concentrated on math education. CAI research has less frequently examined the effectiveness of computers in building informational and research skills or building higher order skills through simulation, model building, gaming or programming. There is very little research on computer literacy training or computer-managed instruction or the effectiveness of CAI in subject areas other than math.

Computer-asssisted instructional research presents both traditional educational research problems and research problems that are unique to computer education. Analysis and comparisons of CAI research indicate that research studies often exhibit the following problems: (1) an inability to isolate the multiplicity of variables that can affect learning and test scores; (2) an inability to control for varying teacher competence; (3) a failure to control for the differences between schools; (4) a failure to control for the differences in the socioeconomic background of students; (5) a failure to control for variation in the kind and quality of the educational software. With these limitations in mind, let us review some recent research findings.

Research In Higher Education

- A study synthesizing the results of 59 primary studies in higher education came to the following three major conclusions: (1) the use of computers produces small but significant contributions to the effectiveness of college teaching; (2) computer-based teaching has a positive effect on attitudes toward instruction generating greater student interest in the subject matter; (3) use of the computer increases the speed of learning (Kulik, 1980).

Research In Secondary Education

- Middle school students using drill and practice computer programs in mathematics and reading had significantly higher standardized test scores than students receiving traditional instruction. Both CAI and control groups were equally effective in achieving reading gains, while elementary mathematics gains were generally higher for CAI students. Teachers perceived CAI as beneficial to student achievement; middle school teachers were less positive but still supportive. Student responses to questionnaires indicated that they perceived CAI drill and practice as personally beneficial and as an enjoyable activity (Lysiak, 1977).

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*Developed by Sheryl Denbo, Director, Mid-Atlantic Center for Race Equity.

- A field study in which the mathematics portion of the Plato basic skills learning system was used in remedial courses for high school and adult education students at three Florida high schools revealed that the Plato system is both educationally effective and cost effective (Brown, 1981).

- When using CAI to strengthen basic skills for economically and educationally disadvantaged students at the secondary level, student outcomes met or exceeded expectations. Student and teacher involvement increased remarkably, and student, parent, and faculty attitudes were very positive (Maser, 1979).

- A secondary study analyzing and synthesizing 51 independent experimental studies of computers in secondary education (grade 6-12) found that improvement in performance of secondary students was greater than college students who had been previously studied. Computer-assisted instruction raised student scores on final examinations and students developed very positive attitudes toward the computer and the courses they were taking. The computer-assisted instruction substantially reduced the amount of time students needed for learning (Kulik, 1983).

Research In Elementary And Junior High Schools

- A study of 5th and 6th grade high achievers in mathematics at West Lafayette (IN) schools showed that access to microcomputers helped children develop problem-solving skills and foster positive attitudes toward mathematics. The experimental group showed a significantly higher rate of improvement on tests of computation and problem solving (Action Research Roundup, 1981).

- A study of 3rd and 4th grade students scoring below grade level in mathematics revealed that those receiving computer-assisted instruction scored significantly higher than the control group (Action Research Roundup, 1981).

- Educational Testing Service (ETS) conducted a four-year research study across the entire spectrum of K-6 curricula, focusing on CAI effectiveness in compensatory education. CAI was found to be an effective learning aid over the long-term, and it was shown that CAI could be easily replicated. In addition, CAI costs were within typical compensatory education budgets (Ragosta, 1983).

- The results of a study which compared problem solving for 8th grade students using the computer with traditional problem solving instruction indicated greater success with the computer (Johnson and Jongejan, 1981).

- Eighth grade students using a computer to solve mathematical problems out-performed groups using more traditional methods of instruction (Foster, 1973).

- Results of an investigation of the effectiveness of computer-assisted instruction with learning disabled students in an elementary school indicate that computer-assisted instruction increased students' mathematics skills (Watkins and Webb, 1981).

Conclusion

It is clear that more research needs to be done on a wider range of instructional uses of the computer, including simulations, model-building and programming as educational tools. To date research indicates that computer-assisted instruction holds promise. It can be an effective teaching tool and it often generates a high level of motivation among students. It also serves to prepare students to comfortably interact with the kind of technology that will surround them in their adult roles. The task of identifying the kind and the quality of instructional uses for the computer is just beginning.

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ELECTRONIC LEARNING

Nov./Dec. 1982

COMPUTERS IN EDUCATION

What the Research Shows

BY GERALD W. BRACEY

ALTHOUGH PREDICTED BY SOME VISIONARIES AND EXPERTS, THE EXPLOSION OF MICRO-COMPUTERS ONTO THE HOME, BUSINESS AND school scenes took practically everyone else by surprise. (Remember the ads that read "Yes! We have Apples in stock again!"?) The resultant frenzy to buy computers for the local classrooms has placed many an educator in an awkward and confusing position. Consider the bewildering array of conflicting claims and exhortations we have been forced to choose between:

- Advertisements urging us to catch the crest of "the third wave"
- Cover stories and TV specials hailing the miracles of the new technologies
- Parent groups holding bake sales, taking evening courses, and sending kids off to trendy computer camps—a. part of the effort to jump on the CAI bandwagon

VERSUS

- "Back-to-Basics" educators who see no need for the technology or who even decry it as a manufacturer-perpetra. d scam
- Education's historical relationship with technology (which may succinctly be described as "disastrous")
- Very tight money

In the swirl of all these conflicts, we should not be surprised to find some teachers and administrators pulling up on the reins of educational computing, and asking anew: What can these computers do? Are they worth it? *What does the research say?* *(Continued)*

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Research

THE QUESTION "WHAT DOES the research say?" looks simple on its face, but turns out to be deceptively complex. In general the answer is: "Not nearly as much as it can, will and already should have." However, even with those caveats and reservations; even when we consider sloppy research design, vested interests, and the variety of nearly uncontrollable variables that every attempt at educational research must somehow deal with, we find that the research shows some results with amazing consistency.

I have grouped these results into three categories which I call achievement, affective/motivational and social. Let's look at each in turn.

What The Research Shows

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IN GENERAL, STUDENTS learn more, retain more or learn the same amount faster using computers.

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Unfortunately, no studies have been completed yet that tell us *why* that may be.

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Achievement gains aside, students often find computers more "human"— more patient, less critical—than humans.

Achievement Outcomes

ACHIEVEMENT OUTCOMES are what most people think of when they first think of CAI effectiveness: Did students learn more using a computer than other students using traditional instruction materials alone?

In general, the answer is yes. Two recently completed pieces of research contribute enormously to my being able to say so.

1 PROFESSOR JAMES KULIK and his colleagues at the University of Michigan have now completed their analysis of 51 separate research studies on students in secondary schools, which they define as sixth grade or above. The 51 studies were the survivors of a careful and thorough search through the research literature, extending back into the 1960's. (Roughly 250 other studies were eliminated, due to "crippling methodological flaws" among other reasons. For a thorough look at Kulik's study and his research techniques, see the box on page 53.)

With rare exceptions, the 51 studies show that students who received computer assisted instruction scored better on objective tests than students who received traditional instruction only. To put it statistically: If all the children in all 51 studies reviewed by Kulik had taken the same norm-referenced test, the average student *not* receiving CAI would have scored at the 50th percentile while the average student who did receive CAI would have scored at the 63rd percentile. The average student receiving CAI, then, would have scored better than 63 out of every 100 students taking the test.

Kulik and company also found two other interesting results: that CAI improved *retention* when students were tested at some time after the CAI program had ended, and that (at least in the studies that tested for it) CAI can also improve the *speed* at which students learn a given amount of material.

While Kulik's analysis includes more studies in physics and mathematics than in other areas, the batch of 51 pretty well covers the academic waterfront; English composition, counseling, biology, chemistry and history are among the other subjects included in his report. To me, one of the more intriguing findings he turned up is that the more recently completed studies (those conducted since the early 'seventies) show a greater impact than the earlier ones. Since educational research methods didn't change materially during the period when the studies were being conducted, what we may be seeing is the impact of improved technology and more appropriate use of that technology. As more than one educator has noted, *how* a medium (such as a computer) is used is much more important than the fact that it *is* used. This intuitive truth has a way of getting forgotten so I repeat it here.

2 IT IS ALSO INTERESTING TO me that Kulik found that the impact of CAI was greater on secondary students than on college students (whom he had studied earlier). There aren't really enough studies around to say definitely that CAI might have an even greater effect on younger—elementary school—children, but one set of recently conducted studies suggests that under certain circumstances it would indeed. These studies were conducted by the Educational Testing Service (ETS) in collaboration with the Los Angeles Unified School District. Using students in grades 1-6, ETS found that tests designed specifically to look at the impact of CAI showed greater effects than the average effect Kulik reported. (General standard tests, however, did not always show quite so significant gains.)

ETS conducted its research across the entire spectrum of K-6 curricula, using materials leased from Computer Curriculum Corporation in Palo Alto, CA. The study was funded by a grant from the National Institute of Education (NIE), and focused on CAI effectiveness in compensatory education.

In her report on the study's results, ETS research psychologist Marjorie Ragosta indicated that the study had been able to answer two of the three basic questions it had set out to investigate: (1) CAI was found to be an effective learning aid over the long-term (at least one year) as well as the short-term; and (2) it was shown that CAI could easily be replicated, "unlike many other approaches to compensatory education"—such as individual tutorial. On the third question, the study found that while CAI costs were within typical compensatory education budgets, they were not proved to be more or less cost-effective than other methods of helping disadvantaged students.

What makes the ETS studies especially noteworthy is the fact that they lasted four full years. Most other studies have been completed in the short-term (one semester or a year), and so are subject to what is known as the "Hawthorne Effect," which shows that the novelty of a change itself sometimes produces temporary improvements. ETS found that in mathematics, children who had access to the computer for only 10 minutes a day scored significantly higher than those who did not have such access. Twenty minutes a day doubled the gain, and as the study progressed, ETS found that the children *increased* these gains over those with no access. In reading and language arts, ETS found smaller but consistently positive gains which were also maintained for the duration of the study.

We can't say from the ETS, or any other study, that CAI is more effective in math than the other areas. In fact, the total number of studies is so small and their diversity so great that I would not risk advising anyone that CAI is more effective in any one subject than in any other. True, the most common finding is that effectiveness seems to be more pronounced in mathematics drill and practice than in other areas, but I would guess this tells us more about the history of computer use than anything else. (ETS, for example, limited its study to drill and practice.) Computers have historically been used more by mathematicians and more for drill and practice than for anything else. We may find in the future that computers used as word processors in composition courses greatly improve the quality of writing because it is easy for students to revise and edit and for teachers to make otherwise laborious corrections—but that is an experiment in my head, not in the research literature.

AFFECTIVE/ MOTIVATIONAL OUTCOMES

ACHIEVEMENT OUTCOMES ARE not the whole story. In fact, my guess is that many people interested in CAI would agree with Ludwig Braun (at the State University of New York, Stony Brook) that the affective outcomes are more important than the achievement effects. Perhaps that's because so many of those same people remember (with too-painful clarity) being on the receiving end of the old "miracle" devices like programmed texts and teaching machines... but after all, what good would it do us to have the most efficient method of teaching reading ever devised if no one taught by it ever picked up a book?

In the area of affective/motivational outcomes of CAI, the news is almost all good. At the college, high school and elementary school levels, students have good things to say about learning from computers. They also emerge with more positive attitudes *about* computers.

Students consistently report that they enjoy the ability to move at their own pace, as well as the lack of embarrassment about mistakes. ("You can learn at your own rate," and "There's no teacher to yell at you" are among the things students said to researchers James Gershman and Evannah Sakamoto in a 1980 study for the Ontario Institute for Studies in Education.)

Terry Rosegrant, an assistant professor at Arizona State University, has research in progress which tends to confirm this assertion that children using computers feel more in control of things. This is important because such feelings affect a child in many ways. Through research he performed at the University of Maryland, Gilbert Austin has discovered that student responses to the statement, "Getting good grades is more a matter of luck than hard work" discriminate between effective and ineffective schools as early as the third grade. It would seem that anything that enhances a child's feelings of being in control of his or her destiny is, in general, beneficial.

SOCIAL OUTCOMES

HERE, "HARD" RESEARCH IS silent, but many of my colleagues and I have seen more collaborative, cooperative problem-solving among kids who are doing programming activities together than anywhere else in schools. Their focus of interest is on getting the program to run, not on being the first person with a hand in the air signalling to the teacher that you've got the right answer. It may be that in an environment where cooperation between students is so often defined as "cheating," such activity provides a welcome relief—to both teachers and students. In any case, many researchers have reported that this observation "jumped out at them."

The oft-expressed fears do not seem grounded, then, that computers will "dehumanize" society by isolating students from their peers in classroom settings. One encouraging note in this regard is the appearance lately of "group-oriented" software—programs meant to encourage interaction between students, rather than occupy them as individuals. The "Search" series now being marketed by McGraw-Hill is one example of this type of programming.

WHAT THE RESEARCH CAN'T SAY

FOR SOME EDUCATIONAL USES of computers, research is irrelevant to us. When students learn skills using computers that they could not acquire in any other way (say as programming), the use of those computers is justifiable. The relevant question here is: How important is it to teach these skills?

The answer appears to be: Critically important. Andrew Molnar of the National Science Foundation and Roy Forbes, Director of National Assessment are among the many who have expressed to me not concern, but *fear*, that we are not preparing our children for the information society in which they will live. ("Terrified" is the word Forbes used.)

The growing demand for people with extensive technical training in information technology is well documented; already, the U.S. is experiencing shortages of engineers and teachers with a math/science background. Suffice to say that regardless of how well computers can assist the teaching of history or composition, their value as vocational tools may make them worth whatever they cost in terms of time and expense.

Computers make contributions in other ways not measurable by research, also. When a student uses a computer to simulate scientific experiments in a school with meager or no laboratory facilities or to simulate events that would be too fast, too slow, too dangerous, or too expensive to conduct in the real world, the student is doing something he or she could not otherwise do. The relevant question here is: How satisfactory are these simulations, particularly at the lower grades?

A recent Request For Proposals (RFP) from the National Institute for Education declared that "If school is an artificial world, surely the computer is more artificial." While some of us might want to challenge that assertion, it *is* meaningful to ask, as the RFP does, "Does the learning in the simulated world transfer to the real world? How so and how not? Do the answers to these questions depend upon the age of the students and the nature of their previous experience?" Teachers who use computer simulations usually point out that they make it a point to discuss the limitations of modeling and simulation as a part of the activity. Simulations using intelligent videodisc may be able to avoid the simplifying assumptions that have to be made for many computer simulations, but the extensive use of videodisc is largely in the future and, in the meantime, questions about simulations remain open and largely unanswered.

WHAT THE RESEARCH SHOULD SAY

TO DATE, MOST RESEARCHERS have limited themselves to looking at whether or not CAI is more effective than traditional instruction. This leaves us with the important question of *why* it might be more effective.

There is a great deal of research now in progress; in making the rounds among educational researchers I knew to be working with the effects of computers, I must have heard "Call me back next year" at least a half-dozen times. Most of that research, however, was aimed at answering this last "Why?" question rather than providing more evidence of the effectiveness of CAI. And, according to at least one specialist—Karen Billings at Houghton Mifflin—that evidence may not be forthcoming, for a very practical reason. "You can't find a group of parents these days who would stand for their children to be the control group—the non-computer-users, when their classmates are getting to use them," Billings said.

One could argue that that's a problem: that the horsecart of public opinion has raced ahead of the research meant to guide it. *Has* there been enough work done on the effectiveness of CAI? Probably not. But educators who are concerned about the rush to stock classrooms with computers may take comfort in the findings of fairly convincing studies like Kulik's and ETS-Los Angeles. Though the horsecart may be moving a bit fast for some onlookers, at least it appears to be on the right track. **EL**

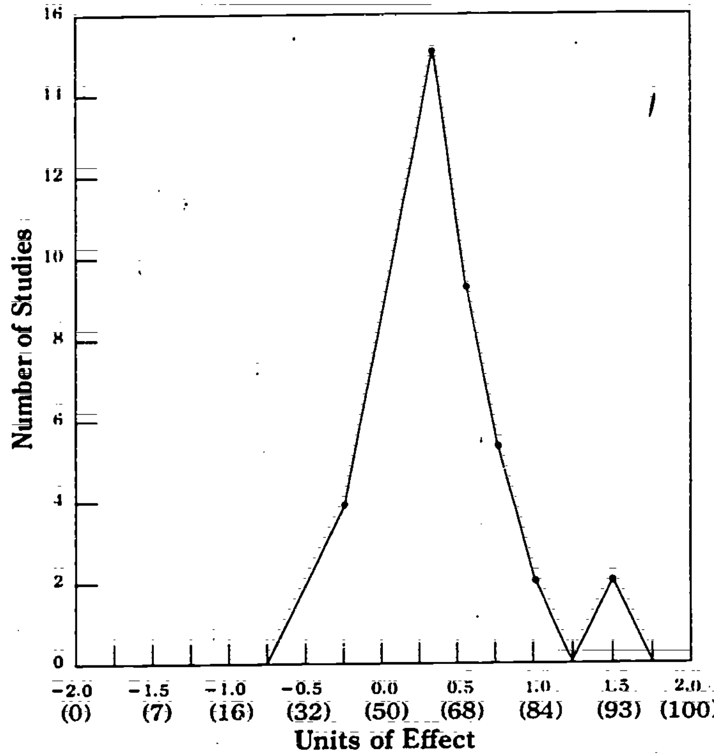
A Close Look At The Kulik Analysis

Research reports take many forms. It's as if some of the studies report their findings in centimeters, some in inches, and others in fathoms. What educational research has needed has been a way to transform these different scales into a common measurement. A technique to do this, called "meta-analysis," was developed largely by Eugene Glass, a professor of education at the University of Colorado. It is a meta-analysis that James Kulik and his colleagues performed on the 51 studies on CAI effectiveness that they reviewed.

In a meta-analysis, each of the odd bits of measured research is translated into standard "units of effect." Each unit represents a certain degree of change away from the norm, which is represented as "0." In the graph shown here, presenting the results of Kulik's analysis, all of the units to the right of "0" represent increasingly positive effects of computer-assisted instruction; all of the negative units to the left of "0" signify instances where CAI actually brought *down* test scores. The vertical axis, meanwhile, indicates the number of studies in Kulik's review that reported a certain degree of positive or negative effect. The greatest number of studies (15) reported that the use of CAI had a positive effect of between .25 and .50 standard units of measurement. No studies reported an effect of +1.25, but two reported gains as high as +1.50; however, several studies did find negative effects of −.25 and −.50.

(To make these standard units of effect more relevant to today's methods of testing and scoring, they are sometimes translated into percentiles. We have done that here, showing the figures in red, underneath the standard units of effect. "0" becomes the 50th percentile—the average score of the "control" group of students who did not receive CAI. The highest point of the graph, showing the results of 15 studies, indicates that the students in these studies who received CAI scored on the average around the 60th percentile.)

EFFECTIVENESS OF CAI* IN 51 RESEARCH STUDIES



*In analyzing his studies, Kulik did not differentiate between the various uses of a computer: Computer Assisted Instruction (CAI), Computer Managed Instruction (CMI), or Computer Based Instruction (CBI). "CAI" is used here as an umbrella term comprising all of these different forms of computer use.

Some General Comments

It is hard to do good research in almost every area, but CAI research presents some special problems. The number of variables that can affect learning and test scoring—teacher competence, quality of the materials, the social and economic background of the students—is staggering, enough to keep a number of researchers away from CAI work because of the difficulty of controlling them all.

So there are lots of ways a study can go wrong, and out of the 300 or so studies that Kulik's search turned up, 250 had to be eliminated due to one reason or another. (Some failed to report scores of the control group; some failed to even *use* a control group; others simply did not appear to handle all of those variables well enough.)

The 51 studies that remained represent a veritable melting pot of different types of CAI research. For example:

- In a doctoral dissertation conducted at Wayne State University in Detroit, MI, William Cole found that using a computer to assist in the instruction of whole numbers, percents, fractions and decimals increased scores in the computation section of the Stanford Achievement Test and on tests that he developed for each topic.
- In another study at Duquesne University in Pittsburgh, PA, Joseph Maola found that high school students learned much more about job requirements from spending an hour a week with a computerized vocational informational system than from an hour a week with a counselor.
- In his doctoral dissertation conducted at the University of Wisconsin, Thomas Foster was able to show that students who received instruction in flowcharting and programming skills scored better on mathematics problem-solving abilities tests than other students who did not.

Though Kulik appears to have been fairly selective regarding the quality of the research, we must keep in mind that he did *not* make any attempt to evaluate the quality of the computer-related materials used. This is important. Good software, obviously, has more potential for producing good effects than bad software; and as I read through the literature of CAI research, I see a lot of "home-grown" material, some of which seems to have been produced so quickly that it is likely to be of dubious quality. The fact that we still find consistently positive effects with CAI may be the most substantive endorsement of educational computing yet.

—G. Brac

"Effects of Computer Based Teaching on Secondary Scho Students," by James Kulik and others. To be published in the *Journal of Educational Research*, early 1983.

How To Manage Effectively with Twenty-five Students and One Computer

by
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Until the day arrives when each classroom has one computer for every student, teachers will continue to search for the best way to effectively organize time at the terminal. Most schools and classrooms lack sufficient numbers of computers to allow the problem to disappear naturally, so panaceas continue to be sought. The purpose of this article is to share with the reader a series of organization strategies to maximize computer use by students and minimize confusion, delay and inefficiency in daily classroom routines. The classroom computer management models described below allow one or two computers to work as an integral part of the self-contained or departmentalized classroom.

Total Class Instruction

Most classroom computers do not have monitors larger than 12''. Therefore, by connecting a 21'' classroom television monitor to the computer by video cable, or cabling a second smaller television located in the other half of the classroom, all students can view output from the computer. This is easier to do with some computers than with others. Local computer or electronic stores can provide advice or the necessary hardware. With two screens, total class instruction can then proceed with simulation programs by having small groups of students interact with each other or the computer. The classroom teacher or student leader enters the group's information into the computer terminal in response to the directions given by the program. All students are participating, and with commercial or teacher-made question sheets, individual responses can be utilized as well. One of the great benefits of computer assisted instruction is the use of simulation—and a classroom charged with excitement, cooperative spirit and . . . learning!

Timed-Use Relay

Often throughout the instructional day, the teacher works with individual pupils or small groups. What might the rest of the class be doing? Independent activities are usually scheduled so that a minimum of pupil interruptions occur for the teacher. Here is where the computer aids in management as well as in reinforcement. Once the software has been loaded into the computer, the teacher schedules each pupil at the terminal for a given period of time. A kitchen timer is set by the student (if an internal computer clock is not available), and the pupil works at tasks until the completion of allotted time. The next scheduled student comes to the computer, resets the program and the timer, and then proceeds with the lesson. Perhaps all pupils do not get to work at the computer during the specific period, but a system of management is now established and children know their sequential time frame.

Block-Time Format

This procedure has its base in the weekly schedule of the teacher plan book. Although more conveniently suited for a self-contained or semi-departmentalized class, it is possible to organize such a routine for a departmentalized class.

Each student in the class is assigned a given period of time that is his/her computer time. (There are approximately twenty-five teaching hours in a school week. With a twenty-five pupil classroom, each child could easily be allotted 20-30 scheduled minutes per week.) A block time format is drawn and posted with pupil names entered and appropriate time delineated.

Non-Scheduled Format

Many teachers can have their students take advantage of time that exists during the school day when formal teaching in the classroom is not being conducted. Before school, after school, indoor free time, study periods, before and after lunch breaks, etc. Computer club time during or after school offers additional opportunities.

Sign-up sheets can be created for these specific blocks and procedural rules established to prevent computer time hoarding—a nice problem to solve!

Effective use of the one-computer classroom means judicious use of systematic procedures for teacher and student. For most schools, given too few computers and too many students, it is important to maximize efficiency. By employing variations on the four basic strategies presented, all pupils can be working with the computer before, during and after school hours. And, as additional computers are acquired, procedures can be easily (and happily) altered!

[Editor's note: LeRoy Finkel explained how to hook up more than one screen to Apple and Atari in the September '81 TCT. We welcome articles or letters explaining how to do that for other brands.] **END**

UNRESOLVED ISSUES

To successfully integrate the computer into the educational process we must face a number of issues. These issues vary from the pragmatic to the philosophical. Our ability to resolve them or even to identify all of their parameters depends on a number of variables that are not always within our control and that are themselves in the process of change. Nonetheless, it is essential that we begin to acknowledge concern for these unresolved issues which may very well prevent the effective use of microcomputers in the educational process.

The central issue is whether or not we should be using computers in the schools. If the answer is yes, we can move on to address how educators can justify the required expenditures when most school districts are facing severe financial constraints.

With the knowledge that we do not have the answers and that we probably have not even identified all of the questions, we will begin to identify some of the specific unresolved questions.

How do educators locate adequate funding and make appropriate purchasing decisions?

a. How do schools identify local, state, federal, and private funds to finance purchasing?

b. What are some successful fund raising techniques used by other districts?

c. How do educational leaders determine an adequate level of funding for computer-related expenditures?

d. How do educators decide how to allocate available resources?

e. Should one purchase computers or, for example, replace an outdated science series?

f. How do schools decide which hardware to purchase?

How do educators locate, evaluate and integrate computer software into the curriculum in a manner that increases educational effectiveness?

a. How do educators identify appropriate educational software to meet the various educational objectives of the school?

b. How do educators determine the cost effectiveness of using computers for a variety of educational tasks?

c. How do educators integrate educational software into the curriculum?

d. How do educators ensure that this new technology is used in a manner which maximizes its potential value for teaching higher order thinking?

e. How do educators ensure that this new technology is not used inappropriately to replace traditionally effective educational techniques?

Finally, how do educators assure that staff and students gain the necessary computer skills to enhance learning?

a. How do educators address teacher-resistance and/or anxiety?

b. How do educators design a staff development program to meet the needs of all teachers and staff?

c. How do educators address student resistance and/or anxiety?

d. How do schools assure computer literacy for all students?

e. How should educators monitor students' access to computer time?

f. How can educators assure that all students have equal access to and participation in computer experiences?

D. Evaluating Software

This chapter contains materials related to evaluating educational software. It includes the following:

Glenn Kleiman — Mary M. Humphrey — T[illegible] Van Buskirk

EVALUATING EDUCATIONAL SOFTWARE

Educators are rapidly becoming aware of the potential of microcomputers. Currently available, relatively inexpensive, computer hardware is capable of providing powerful and flexible tools for teaching. Computers can be used to individualize instruction, maximize children's attention and present material in new ways through the use of graphics and simulations. Computers can be tutors that provide appropriate levels of instructions and questions for each individual. They can provide immediate feedback to students' answers, and they are infinitely patient. They can also keep detailed records of each student's performance.

Unfortunately, much of this potential remains unfulfilled. By itself, a computer is a dormant set of electronic components. No matter how potentially powerful, the usefulness of a computer is determined by the software available for it.

The development of educational software lags far behind the development of hardware. Many of the available programs are poorly designed, do not take advantage of the potential of computers, and are difficult for students and teachers to use. We fear that the use of poor software will discourage some educators from using computers at all.

Some good educational software is available, and much more should be available in the near future. Our aim in this article is to present guidelines for selecting good software. We will discuss the general principles that we, as educators, psychologists and computer specialists, believe should form a basis for both software development and software evaluation.

Since we will focus on general principles rather than specifics, what we have to say is relevant to a wide variety of teaching programs, topics, students, and computer systems. The guidelines are presented as questions one should ask about any computer software designed for educational use.

First we will discuss three very general questions. Then we will turn to more specific questions that are based upon the three general ones.

One general question is: Does the software follow good educational practices. Much of the available educational software seems to have been written by computer programmers who do not know much about education or the abilities of the children who might use the program. Such software may be of high quality from a programming point of view, but it often contains serious flaws from a pedagogical point of view.

For example, educationally well-designed programs present material in small, well-sequenced units. We have seen many programs that present too much material at one time, and present it in ways that may be confusing to many children.

Another good educational practice is to provide immediate feedback when the student makes a response. Computers can be programmed to do so, but many programs do not take advantage of this capability.

Other programs make poor use of the graphics capabilities of computers. A common fault is using graphics in ways that distract the child from the material to be learned.

Another general question is: *Is the software suitable for the intended purposes and users?* Some educational software does not present a reasonable progression of material to be learned and therefore will not fit into any curriculum.

Other computer programs are not acceptable because they are difficult for students and teachers to use. Many lack adequate instructions, do not take into account the reading level of the intended users, require complicated procedures to enter answers, or stop operating if the user makes an inappropriate response.

The remaining general question is: *Does the software take advantage of the capabilities of the computer?* The major reason for using computers as educational tools is that you can do things with computers that cannot be done, or are much more difficult to do, without them. However, computer programs often do not take advantage of the capabilities of the computer.

For example, we consider programs that are basically written pages moved onto the computer screen, in which the computer simply acts to turn the pages, to be a waste of computer resources. Some lessons are better presented with other media. Since most schools do not have an abundance of computers, the available computers should be used for those types of lessons for which they offer strong advantages.

We now turn to the more specific questions, each of which reflects one or more of these general concerns.

Does the Program Fulfill Its Purpose?

Computers can be used in teaching a wide variety of topics, and one must decide whether a given program fits into the curriculum being used. Once a match between the curriculum and a software package has been found, there are several other considerations regarding the role of the computer.

One must decide whether the computer will be used in the initial teaching of the material, for review or practice, for testing, for record keeping, for facilitating general skills, or for some combination of these functions.

Deciding which of these purposes one wants a given program to serve is an important step in evaluating the potential usefulness of the program.

Computers can be helpful in the initial teaching of material. For example, computer graphics and animation can provide useful visual aids. In some cases, computers can substitute for the teacher and textbook and actually teach the material.

Another possible role for the computer is to review lessons or present drill and practice. Since they are infinitely patient, computers can be especially useful for those students who need more repetition. Programs can be written to ask the student questions and give feedback when he answers.

Since computers can keep track of students' performance, they can also serve in testing and in record keeping. Well designed testing programs allow the teacher to enter questions and acceptable answers.

Does the program use sounds or graphics that might distract other children in the room?

Various criteria can then be set to individualize the test for each student. For example, programs can be designed to vary the difficulty of the questions presented depending on how many the student has answered correctly. With a printer, connected to the computer, written records can be produced automatically.

In addition to helping children learn and master specific material, computers can be important in facilitating general skills. For example, many computer games provide good practice in eye-hand coordination, making rapid responses, and maintaining attention. Other computer games exercise general problem solving and creative skills.

Is the Software Appropriate for the Situation in Which It Will Be Used?

When evaluating software, one should keep in mind where and when it will be used. Will an adult be present to assist the student, or should the student be able to use the program without assistance? Will children work individually or in groups?

If they will work in groups, one should consider whether the program is designed so that children can share the work or alternate entering responses.

How often will each child use the program, and for how long? If a program is very repetitious, it might be suitable if it will be used only occasionally and briefly.

If a program is fairly complicated and will take a while to learn to use, it will be suitable only if sufficient computer time is available. Finally, will it be used in the classroom and, if so, does it use sounds or graphics that might distract other children in the room?

Is the Software Suitable for the Intended Users?

As we mentioned above, much of the available educational software seems to have been produced by computer programmers who know little about the children who might use the programs. One important area of concern is the instructions provided with the program.

Many educational programs do not provide adequate instructions. Often the instructions designed for the child are unsuitable because of the reading level required. For example, we have seen instructions requiring high school level reading in math programs designed for grade school children.

Many programs also fail to provide adequate intructions for the teacher on how best to use the program. In several programs, we have happened upon useful features that were never mentioned in the instructions.

Another important concern is how the user makes responses. There are many ways in which information can be entered into a computer. The most common ones use typewriter or calculator style keyboards. Young children can usually use these to enter single letter or digit answers. However, entering entire words or sets of words may be too difficult for young children.

Other input devices can be attached to computers. Light pens enable responses to be made by pointing at a particular part of the screen. Using a light pen, a child can answer multiple choice questions without needing to find the appropriate keys on the keyboard.

Other devices, such as joysticks and game paddles, also provide easy ways of making responses.

The pacing of the material being presented should also be considered. In some programs it is completely controlled by the computer. In other programs the material is presented in small units and the user presses a key to advance to the next unit. Since different children work at different rates, we generally prefer programs where the pacing is controlled by the user. The main exceptions are programs used to increase speed, such as in rapid word recognition. Even in these programs, there should be a range of speeds available so they can be used with a variety of children.

Does the Software Adapt the Computer to the User or Must the User Adapt to the Computer?

A very important consideration, often neglected by programmers, is whether the students and teachers will be able to use the program easily and comfortably. Psychologists call this area human factors—considering the people, not the machines.

Most addition programs provide examples of programmers' failure to adapt the computer to the user. When children do addition problems with paper and pencil, the addends are usually written one below the other, with the columns in line. The children work the problem from right to left, and mark carrying from one column at the top of the next.

Many addition programs present the problems with the addends side by side, require the answers to be entered from left to right, and do not provide any way of marking carrying. In using these programs, children often copy the problem, work it on paper, and then enter their answer into the computer.

Programs that present problems this way force the u... to adapt to the computer. With more ... on the part of the programmer, the computer could have been adapted to the user.

Other examples of failing to adapt the computer to the user include using "*" instead of "x" to indicate multiplication, not providing any way in which mistakes can be erased, and filling the screen with so much information that it is difficult to read.

Another thing that makes programs difficult to use is lack of consistency. One should check whether the way information is entered is consistent within the program, and, if possible, is consistent with other programs the children might use. For example, on the PET computer a key marked DEL (for delete) is usually used to erase responses. A program that uses some other key, or does not allow erasing, or only allows erasing some of the time, may confuse children who are accustomed to using the DEL key.

We hope that educational programmers will agree to a set of standard input procedures in the near future. As things stand now, educators should look for sets of programs that operate in similar ways.

Another problem good programmers should consider is that users do not always make the expected response. For example, given a choice of pressing "Y" for yes or "N" for no, an uncertain child might press "M" for maybe. Children often press keys just to see what will happen, and we have observed children pressing an "Erase" key to try to erase a difficult question. Good programs are prepared for inappropriate responses, so that these responses will either be ignored or result in a message such as "try again."

Given a choice of pressing "Y" for yes or "N" for no, an uncertain child might press "M" for maybe.

Poor programs are not child proof and may "crash" when inappropriate responses are made. When testing any program, one should make sure that inappropriate responses will not disrupt the program.

Does the Software Take Advantage of the Capabilities of the Computer in Presenting the Lessons?

Many lessons, creatively designed, can take good advantage of the graphics and sound capabilities of the computer. Any lesson where animation or interactive graphics can be useful is better presented on a computer than a book.

For example, many lessons in physics, such as those on wave forms or vectors, can benefit from animated representation of the phenomenon being studied.

Other examples include programs that produce maps and point to them during lessons, programs in which graphs are produced and revised to support the information presented, and programs which enable the user to, in some way, draw on the screen.

Other lessons, such as those in music, can take advantage of sound generation capabilities—the student can both see the note on the screen and hear it, different sequences can be played, and so on.

In addition to using the built-in capabilities, other devices can be interfaced to computers. Sound can be easily and inexpensively added to computers that do not have it built-in. Interfaces have been designed to enable computers to control tape recorders, slide projectors, and video recorders. We hope to see greater educational use of computers controlling these presentation devices.

Is the Program Adaptable to Different Children and Teaching Methods?

A good educational program can be easily adapted for different users. For example, a program that can only present 10 addition problems, with each problem having two addends and two digits per addend, is very poor. A program that allows you to specify the number of problems you want is a small bit better. A program that allows you to set different difficulty levels for the problems as well as the number of problems is much better. A program that also gives you the option of using subtraction, multiplication or division problems is better still. The lack of this type of flexibility is one of our most common criticisms of available programs.

Some software companies market a large package of programs where one flexible program would serve the same purpose and be much less expensive.

For example, one company sells sets of 24 spelling programs. Each program contains a small number of words, and the only differences among the programs is in the word lists. It would not be difficult to write a similar program in which the teacher could input his own spelling words. This program could sell for a fraction of the price of the large package.

When obtaining flexible programs, one must be careful that they are easy to modify. Some provide a simple "menu," from which the user selects the desired options by pressing one or two keys. Menus are very easy to use. Other programs require the user to change the program itself, usually by modifying DATA statements or changing the values assigned to certain variables.

Will the Program Hold the User's Attention?

Another important question is whether the program will capture and hold the

...I get more work done if it would pause for commercials

user's attention. Properly designed educational programs have been successful in keeping even the most distractible children engaged in a task for surprisingly long periods of time (see "Microcomputers and Hyperactive Children" by Kleiman, Humphrey and Lindsay in *Creative Computing*, March, 1981).

The graphics and sound capabilities of microcomputers, properly used, can hold children's attention. Improperly used graphics and sound can quickly become annoying and discourage use of the program. When examining these aspects of a program you should determine not just whether they are initially captivating, but whether they will remain so with repetition.

For example, a program that displays a rocket ship slowly rising on the screen, or plays a melody after each correct answer, might be initially motivating. However, after one has seen or heard this ten times it will probably become tiresome. We find that graphic and sound reinforcement which is used repeatedly should be rapid (i.e., two to three seconds) and varied. Different pictures or tunes hold attention much better than the same one or two repeated frequently.

The pacing of the program and the frequency of user responses also affect how well it holds children's attention. A program in which the child has to wait long periods, or which moves more quickly than the child can read or give answers, will not hold the child's attention. Likewise, the more frequently the child must make a response, rather than simply watch the screen, the more likely he will stay engaged in the program. Receiving immediate feedback to their responses also helps hold children's attention.

In many cases, educational material can be presented in a game format. We do not believe that all educational programs need to be forced into games. However, the competitive nature of games often does hold children's attention. The competition can either be against one's own prior performance, against the computer, or against another person.

Game programs should be checked to make sure the children will be able to play reasonably well, but still find the game challenging. A game which is too simple or too difficult will not keep one's interest. The best game programs allow the user to set the level of play—e.g., present the older or more capable users with more difficult questions or less time to perform the task.

A good computer program—particularly one designed for use by children with concentration problems—can monitor the child's responses and provide special messages. For example, the program can measure the time between the user's responses, and flash a special message or sound a buzzer if there is no response for a long time. We have not found many programs that do this, but we have found it useful in our research.

Does the Software Provide Useful Feedback to the User?

One of the major advantages of computer-based learning over other media is the capability of immediate feedback. As we mentioned above, immediate and frequent feedback helps keep childrens' attention on the task at hand, and this is especially important for children with attention problems. The right feedback at the right time is also important for facilitating learning.

Besides the motivating reinforcers for correct responses, an important aspect of a program is how it responds to incorrect responses. One poor but common type of response is simply to tell the child that he is wrong, and go on to the next part of the program. Some programs, written without any thought about who might use them, even display insulting messages after a wrong response. Messages from a computer such as "Wrong, Dummy" may be humorous to some adults, but can upset young children.

Messages from a computer such as "Wrong, Dummy" may be humorous to some adults, but can upset young children.

One good practice is to provide the child with a second chance when an incorrect response is made. For some purposes, this is best combined with a prompt of some sort. For example, a spelling program might tell the child which letters are incorrect, and then have him try to spell the word again. In programs where the questions are based on an immediately preceeding lesson, the appropriate section of the lesson might be repeated when the child does not answer a question correctly.

Another alternative is to give the child the correct answer. Depending on the content of the lesson, this may be best after a single incorrect response, or it may be better to give the child several tries before giving the correct response. In either case, a good practice is to provide some way for the child to compare his answer with the correct one, or to spend some time studying the correct one.

For example, in spelling programs the child should have to type the word correctly after being shown the correct spelling. Another good practice is for the program to store a record of the questions or problems the child answered incorrectly. These can be repeated later on, or given to the child at the end of the lesson for further study.

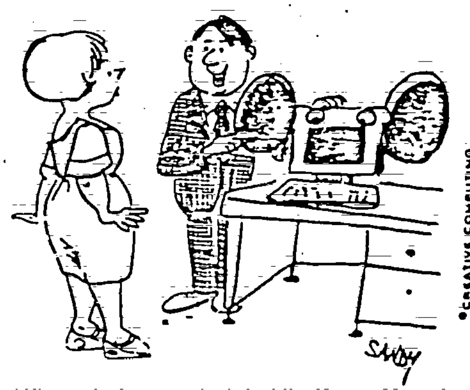
We have seen programs where the most interesting graphics and sound displays occurred in response to incorrect answers. These programs should be avoided, as they encourage children to make incorrect responses just to see what happens.

Other programs are designed to accept only the correct response. For example, some math programs will not let any but the correct number appear on the screen—if the child presses an incorrect number nothing happens. Faced with this type of program, some children just press all possible keys until they happen to hit the correct one, without paying any attention to the math problem. Clearly, this is not a recommended practice.

Conclusions

We have discussed several questions to be asked when evaluating educational software. All of them reflect three general requirements for quality educational software: 1) It must follow good educational practices; 2) It must be suitable for the intended purposes and users; and 3) It must take advantage of the unique capabilities of computers. Within these three general guidelines, which of the specific questions is most important depends upon the material being taught, the teaching method, the students' abilities, the available computer hardware, and other factors specific to each situation.

We hope this article will help teachers, educational administrators, and parents choose the best available educational software. We also hope it will encourage and facilitate the writing of good educational programs. □



"We electronic gadgets feel the Minnie Mouse style CRT is less intimidating for the younger or the timid child."

18 QUESTIONS TO ASK *BEFORE* YOU BUY

ONCE YOU'VE DECIDED WHAT administrative tasks you want to microcomputerize, and have collected a list of potential software packages, it's time to start asking some questions about those packages. The worksheet on this page can help you collect your information.

The 18 questions on this worksheet are divided into three categories. You (or your secretary) should be able to get answers to the Preliminary Questions over the phone, either directly from the manufacturer or from your local computer dealer. In order to answer the Documentation and "Hands-On" questions, however, it will be necessary to have the program in front of you.

The questions are generic—that is, they apply to virtually all of the administrative software you might consider. Although the answers won't necessarily reveal the one program that is right for your school, they should tell you which programs seem to be in the right ballpark.

Here are a few additional notes about seven of the questions:

Question 1. An educator who's already used the program should be your second phone call; he or she will probably be your best source of information. Be wary of any company that refuses to release the names of its satisfied customers; there may just be a reason why.

Question 2. If not, what other compensation can the dissatisfied purchaser obtain?

Question 3. Most adequate: free backups or at least copies at significant discounts with the purchase. Adequate: a firm promise to send a copy *by overnight mail*, should your copy ever crash.

Question 8. Meaning: Can the data you produce by using one program application (say, scheduling) be used as input for another application—say, attendance?

Question 11. You may find it difficult if you wind up having to use more than two disks to store records for a certain application. Larger schools and districts may have to go with the greater capacity of a hard disk system; even though it's more expensive, it's probably worth it in the end.

Question 13. When the program asks for data, you should be able to figure out what it's asking for, and how you can deliver it.

Question 15. A menu-driven software package is composed of a number of separate programs designed to perform different tasks. The menu, or list from which you select the program you want to use, should be comprehensible and arranged in the sequence of operations you would normally use.

An Administrative Software Worksheet

Name of Program:________________ **Company:**________________

Application:________________ **Address:**________________

Price:________________ **Phone:**________________

Preliminary Questions

____ 1. Can the company provide the names and phone numbers of at least two schools or districts where the program is being used successfully?

____ 2. Can the software be returned for a full refund within 30 days after receipt?

____ 3. Does the company make adequate provision for back-up copies?

____ 4. If the software is to be used at multiple sites, will the company sell multiple copies at a discount?

____ 5. Does the software provide for some form of security, especially for financial and confidential student data?

____ 6. Is any user training provided as part of the purchase price?

____ 7. Is support and service available from the supplier through a toll-free number?

____ 8. Is the program integrated with any other application program? (And if not, is the company planning on doing so in the near future?)

Documentation Questions

____ 9. Is the documentation provided with the software complete, clear, understandable, well-organized and indexed?

____ 10. Does the company provide updates to the documentation and the software periodically and at little or no extra cost?

____ 11. Does the documentation tell you how many individual records can be stored on a single floppy or hard disk? (Or does it provide you with an understandable way to calculate the number yourself?)

Hands-On Questions

____ 12. Can you understand what the program is doing easily enough so that it would not require more than three or four hours to learn to use it?

____ 13. Are input fields well-defined and self-prompting?

____ 14. Are input errors diagnosed and described in an understandable way?

____ 15. Is the software menu-driven? Is the order of selection on the menu the same as the sequence of operation of the programs in normal use?

____ 16. When the software is running, does it give the user feedback about what part of the processing is taking place?

____ 17. Are the reports the software produces formatted in an easy-to-read manner, using appropriate abbreviations, spacing, and print size?

____ 18. Does the design and format of information produced by the program meet district, state, and/or federal requirements so that the data will not have to be entered onto other forms by hand?

Permission is granted to make copies of this Worksheet for private use only

"The Administrator's Worksheet" was prepared by Chase W. Crawford, computer consultant for educational administration at the Florida Department of Education.

Northwest Regional Educational Laboratory

microSIFT

COURSEWARE EVALUATION

Package Name________________________________Version______________

Reviewer's Name________________________________Date______________

1. Describe Package Content and Structure. (Provide additional detail on separate sheets if desired.)

Excerpt from Evaluator's Guide developed by MicroSIFT, a project of Computer Technology Program, NWREL, 300 S.W. Sixth Avenue, Portland, Oregon 97204.

Northwest Regional Educational Laboratory

RATING: Circle the letter abbreviation which best reflects you judgment (use the space following each item for comments).

IMPORTANCE: Circle the letter which reflects you judgment of the relative importance of the item in this evaluation.

☐ Check this box if this evaluation is based partly on your observation of student use of this package.

	RATING: Strongly Agree	Agree	Disagree	Strongly Disagree	Not Applicable	IMPORTANCE (OPT): Higher	Lower	
CONTENT	SA	A	D	SD	NA	H	L	1. The content is accurate.
	SA	A	D	SD	NA	H	L	2. The content has educational value.
	SA	A	D	SD	NA	H	L	3. The content is free of race, ethnic, sex, and other stereotypes.
INSTRUCTIONAL QUALITY	SA	A	D	SD	NA	H	L	4. The purpose of the package is well-defined.
	SA	A	D	SD	NA	H	L	5. The package achieves its defined purpose.
	SA	A	D	SD	NA	H	L	6. Presentation of content if clear and logical.
	SA	A	D	SD	NA	H	L	7. The level of difficulty is appropriate for the target audience.
	SA	A	D	SD	NA	H	L	8. Graphics/color/sound are used for appropriate instructional reasons.
	SA	A	D	SD	NA	H	L	9. Use of the package is motivational.
	SA	A	D	SD	NA	H	L	10. The package effectively stimulates student creativity.
	SA	A	D	SD	NA	H	L	11. Feedback on student responses is effectively employed.
	SA	A	S	SD	NA	H	L	12. The learner controls the rate and sequence of presentation and review.
	SA	A	D	SD	NA	H	L	13. Instruction is integrated with previous student experience.
	SA	A	D	SD	NA	H	L	14. Learning is generalizable to an appropriate range of situations.
TECHNICAL QUALITY	SA	A	D	SD	NA	H	L	15. The user support materials are comprehensive.
	SA	A	D	SD	NA	H	L	16. The user support materials are effective.
	SA	A	D	SD	NA	H	L	17. Information displays are effective.
	SA	A	D	SD	NA	H	L	18. Intended users can easily and independently operate the program.
	SA	A	D	SD	NA	H	L	19. Teachers can easily employ the package.
	SA	A	D	SD	NA	H	L	20. The program appropriately uses relevant computer capabilities.
	SA	A	D	SD	NA	H	L	21. The program is reliable in normal use.

22. CHECK ONE ONLY

____ I would use or recommend use of this package with little or no change.

____ I would use or recommend use of this package only if certain changes were made.

____ I would not use or recommend this package.

This work was devloped under contract #400-80-0105 with the National Institute of Education, U.S. Department of Education. However, the content does not necessarily reflect the position on policy of that agency, and no official endorcement of these materials should be inferred.

24. If you would consider using this package describe procedures for its effective use in specific classroom settings.

---

25. List one or two major strengths of the package with supporting comments.

---

26. List one or two major weaknesses of the package with supporting comments.

---

27. [ ] In the box at the left, indicate your overall opinion of this package by writing an integer from 1 to 10 (10 being the high value).

SOFTWARE EVALUATION CHECKLIST

PROGRAM NAME: ______________ SOURCE: ______________ COST: ________

SUBJECT AREA: ______________ REVIEWER'S NAME: ______________ DATE: ________

1. INSTRUCTIONAL RANGE

______________ grade level(s)

______________ ability level(s)

2. INSTRUCTIONAL GROUPING FOR PROGRAM USE

_____ individual

_____ small group (size: _____)

_____ large group (size: _____)

3. EXECUTION TIME

_____ minutes (estimated) for average use

4. PROGRAM USE(S)

_____ drill or practice

_____ tutorial

_____ simulation

_____ instructional gaming

_____ problem solving

_____ informational

_____ other (______________)

5. USER ORIENTATION: INSTRUCTOR'S POINT OF VIEW

low				high	
•	•	•	•	•	flexibility
•	•	•	•	•	freedom from need to intervene or assist

6. USER ORIENTATION: STUDENT'S POINT OF VIEW

low				high	
•	•	•	•	•	quality of directions (clarity)
•	•	•	•	•	quality of output (content and tone)
•	•	•	•	•	quality of screen formatting
•	•	•	•	•	freedom from need for external information
•	•	•	•	•	freedom from disruption by system errors
•	•	•	•	•	simplicity of user input

7. CONTENT

low				high	
•	•	•	•	•	instructional focus
•	•	•	•	•	instructional significance
•	•	•	•	•	soundness or validity
•	•	•	•	•	compatibility with other materials used

8. MOTIVATION AND INSTRUCTIONAL STYLE

passive				active	
•	•	•	•	•	type of student involvement

low				high	
•	•	•	•	•	degree of student control

none	poor				good	
•	•	•	•	•	•	use of game format
•	•	•	•	•	•	use of still graphics
•	•	•	•	•	•	use of animation
•	•	•	•	•	•	use of color
•	•	•	•	•	•	use of voice input and output
•	•	•	•	•	•	use of nonvoice audio
•	•	•	•	•	•	use of light pen
•	•	•	•	•	•	use of ancillary materials
•	•	•	•	•	•	use of ______________

9. SOCIAL CHARACTERISTICS

present and negative	not present	present and positive	
_____	_____	_____	competition
_____	_____	_____	cooperation
_____	_____	_____	humanizing of computer
_____	_____	_____	moral issues or value judgments
_____	_____	_____	summary of student performance

From: Heck, W.P., Johnson, J. and Kansky R.J. Guidelines for Evaluating Computerized Instructional Materials. National Council of Teachers of Mathematics, 1906 Association Dr., Reston, VA 22091 $3.75

1. The grade levels and ability levels for a particular program are primarily determined by the concepts involved. Other important factors are reading level, prerequisite skills, degree of student control, and intended instructional use. It is possible for a program to be flexible enough to be used across a wide range of grade levels and ability levels.

2. Some programs are designed for use by individuals. Others have been or can be modified for participation by two or three persons at a time. Simulations or demonstrations often pose opportunities for large-group interaction. A given program may be used in more than one grouping, depending on the instructor.

3. The time required for the use of a program will vary considerably. Include loading time for cassettes. A time range is the appropriate response here.

4. Instructional programs can be categorized according to their uses. Some programs may have more than one use, thus falling into more than one of the following categories:

Drill or practice: Assumes that the concept or skill has been taught previously.

Tutorial: Directs the full cycle of the instructional process; a dialogue between the student and the computer.

Simulation: Models selected, alterable aspects of an environment.

Instructional gaming: Involves random events and the pursuit of a winning strategy.

Problem solving: Uses general algorithms common to one or more problems.

Informational: Generates information (data).

5. These are factors relevant to the actual use of the program from the point of view of an instructor.

Flexibility: A program may allow the user or the instructor to adjust the program to different ability levels, degrees of difficulty, or concepts.

Intervention or assistance: A rating of "low" means considerable teacher intervention or assistance is required.

6. These are factors relevant to the actual use of the program from the point of view of a student.

Directions: The directions should be complete, readable, under the user's control (e.g., should not scroll off the screen until understood), and use appropriate examples.

Output: Program responses should be readable, understandable, and complete. If in response to student input, the output should be of an acceptable tone and consistent with the input request.

Screen formatting: The formats during a program run should not be distracting or cluttered. Labels and symbols should be meaningful within the given context.

External information: A program may require the user to have access to information other than that provided within it. This may include prerequisite content knowledge or knowledge of conventions used by the program designer as well as maps, books, models, and so on.

System errors: Syste[illegible] the involuntary termination of the program.

Input: A program sh[illegible] a user knows when and in what form input is needed. It should avoid using characters with special meanings, [illegible] locations to particular screen areas, and require minimal typing.

7. These are matters [illegible] the subject-matter content of the program.

Focus: The program topic should be clearly defined and of a scope that permits thorough treatment.

Significance: The instructional objectives of the program must be viewed as important by the instructor. Also, the program should represent a valid use of the computer's capabilities while improving the instructional process.

Soundness or validity: The concepts and terms employed should be correct, clear, and precise. Other important factors are the rate of presentation, degree of difficulty, and internal consistency.

Compatibility: The content, terminology, teaching style, and educational philosophy of the program should be consistent with those generally encountered by the student.

9. Competition, cooperation, and values are concerns that may be a function of the way a program expresses them. (War gaming and the "hangman" format are sample issues.) Also, the "humanizing" of the computer may serve for motivation or to reduce anxiety, but it also may become tedious, misleading, and counterproductive.

T[illegible]nary of student performance can be dichotomous (win or lose), statistical (time expended or percent of items correct), or subjective (as in the evaluation of a simulation). It may be for student, teacher, or both.

COURSEWARE EVALUATION FORM

Name of program ______________________

Manufacturer's or distributor's name ______________________

Address ______________________

Cost __________ Copyright/date ______________________

Available for what microcomputers (model and memory) ______________________

Peripherals needed ______________________

Reviewer's name ______________________ Date __________

Description of program ______________________

____

____

Appropriate grade level: primary inter. jr. high sr. high college

Type of computer application(s) (check one or more)

- ____ simulation
- ____ tutorial
- ____ drill and practice
- ____ game
- ____ problem solving
- ____ remediation
- ____ enrichment
- ____ management (only)
- ____ diagnostic/prescriptive
- ____ other ______________________

Kinds of courses for which this program is appropriate

____

Prerequisite skills or courses needed

____

ANALYSIS (Check yes, no or not applicable)	YES	NO	NA
a. Content has clear instructional objectives.	____	____	____
b. Content is accurate.	____	____	____
c. Content has educational value.	____	____	____
d. Content is free of stereotypes.	____	____	____
e. Content expresses positive human values.	____	____	____
f. Program is appropriate for targeted audience.	____	____	____
g. Computer branches to appropriate difficulty.	____	____	____
h. Graphics/sound/color have instructional value.	____	____	____
i. Frame display is effective.	____	____	____
j. Students can use program easily.	____	____	____
k. Teachers can utilize the program easily.	____	____	____
l. Documentation is comprehensive.	____	____	____
m. Computer is an appropriate tool for activity.	____	____	____
n. User can control rate/sequence/directions.	____	____	____
o. Feedback used is effective and appropriate.	____	____	____

RECOMMEND for purchase? ___yes ___no ___conditional on:

M.E.C.C.
STUDENT EVALUATION OF MICROCOMPUTER MATERIALS

STUDENT'S NAME ______________________ GRADE ________

SCHOOL ______________________ TEACHER ______________________

DATE ______________________ PACKAGE TITLE ______________________

PROGRAM NAME ______________________ APPROXIMATE AMOUNT OF TIME SPENT ______________________

CIRCLE THE BEST ANSWER:
(Write comments if you want)

Using this lesson was: Comments: ______________________

1. Easy
2. Somewhat hard
3. Very hard

After doing this lesson I would: Comments: ______________________

1. Like to do another like this
2. Rather not do any more lessons like this

From doing this lesson I learned: Comments: ______________________

1. A lot about the subject
2. A little bit about the subject
3. Nothing

Describe what you would do to make this lesson better. ______________________

Thank you for your help!

HUMAN VALUES CRITERIA FOR EVALUATING EDUCATIONAL SOFTWARE

Since most educational software evaluation forms do not contain criteria related to human values, the Mid-Atlantic Centers for Race and Sex Equity have developed these five items that can be incorporated into any software assessment. These criteria may be duplicated and used as long as credit is given to the centers.

1.	Is the language used in the educational software free from bias on the basis of race, sex, ethnic group, or disability?	Yes	No
2.	Are the text and graphics free from stereotyping on the basis of race, ethnic group, sex or disability?	Yes	No
3.	Are women and minority group members proportionally represented in text and graphics?	Yes	No
4.	Are the contributions of all racial and ethnic groups and women and men presented in realistic and/or historically accurate ways?	Yes	No
5.	Is the educational software free from violence or extreme forms of competition?	Yes	No

Developed by
The Mid-Atlantic Centers for Race and Sex Equity
The American University
April 1983

E. Statistical Overview: A Look at the Labor Force

This section presents an overview of the participation of minorities and women in computer-related employment areas and educational programs. The chapter also presents projected occupational growth trends. The following tables and informational articles are included:

STATISTICAL OVERVIEW: A LOOK AT THE LABOR FORCE*

"The number of computers in operation has been increasing steadily during the last decade. With the introduction of microcomputers that increase has been accelerated. Estimates indicate that in 1970 100,000 computer systems were in use; by 1980 that increased to 600,000" (U.S. Department of Labor, 1981).

With the increase in computer systems there has been an accompanying increase in the number of people employed in computer-related occupations. From 1972 to 1981 the number of computer programmers increased by 95% and the number of systems analysts increased by 184%. During the same period computer service technicians increased by 117% and computer peripheral equipment operators increased by 183%. (See charts 1 & 2.) The increase in computer workers has been apparent in many industries. (See chart 3.)

CHART 1: EMPLOYMENT IN COMPUTER OCCUPATIONS BY RACE & SEX 1972 & 1981

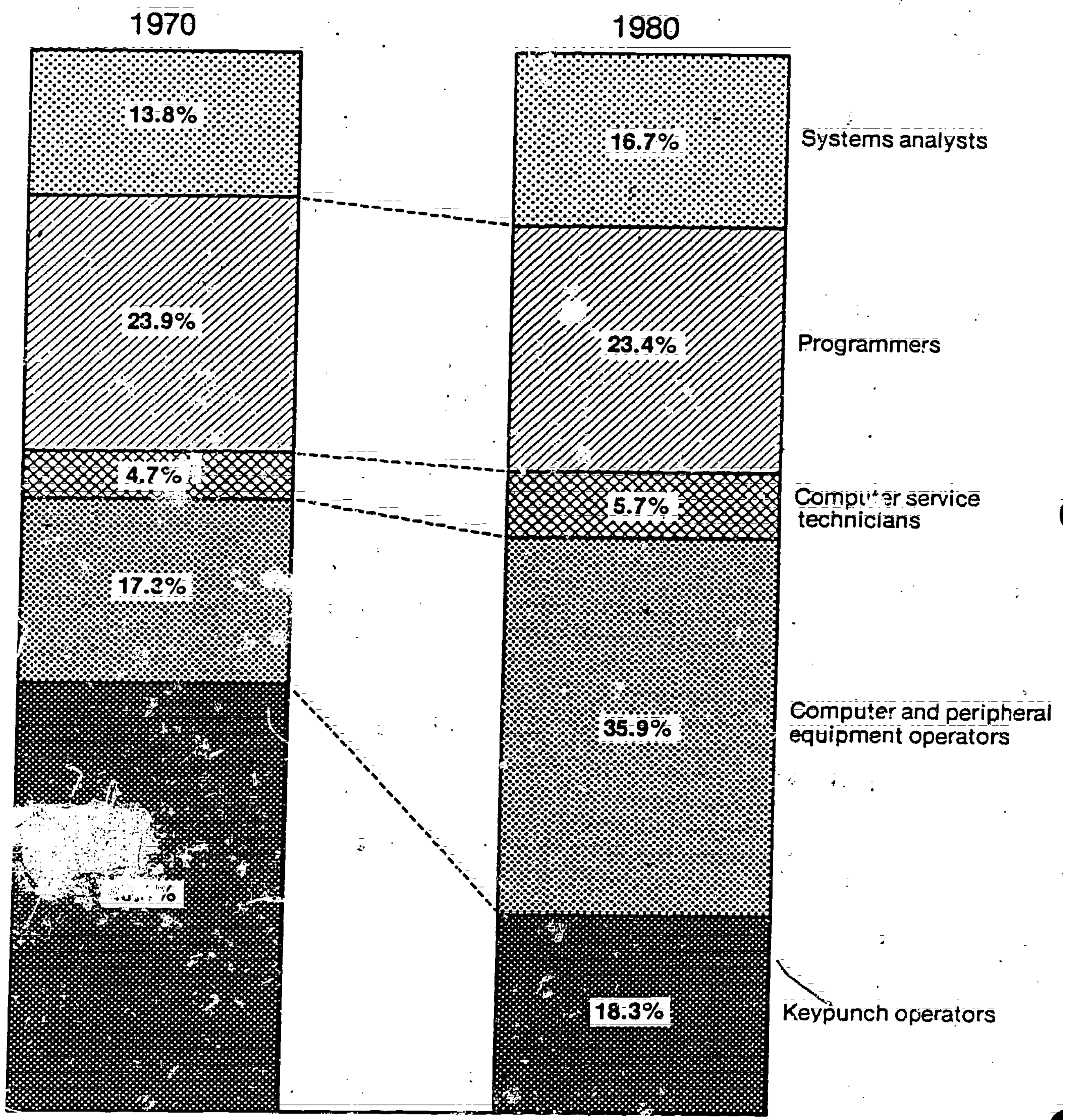
	1972			1981		
	Total No. in Thousands	% Black & Others	% Female	Total No. in Thousands	% Black & Others	% Female
Total Work Force	82,153	10.5	38.0	100,397	11.6	42.8
Programmers	188	5.4	19.9	367	10.4	29.4
Systems Analysts	75	5.4	10.8	213	8.0	25.8
Computer Service Technicians	46	4.4	2.2	100	8.0	7.0
Computer & Peripheral Equipment Operators	199	10.2	37.8	564	15.8	63.8
Key Punch Operators	284	15.5	89.8	248	19.4	93.5

Source: U.S. Department of Labor

Programmers, systems analysts and service technicians tend to be the higher salaried computer occupations while computer equipment operators and keypunch

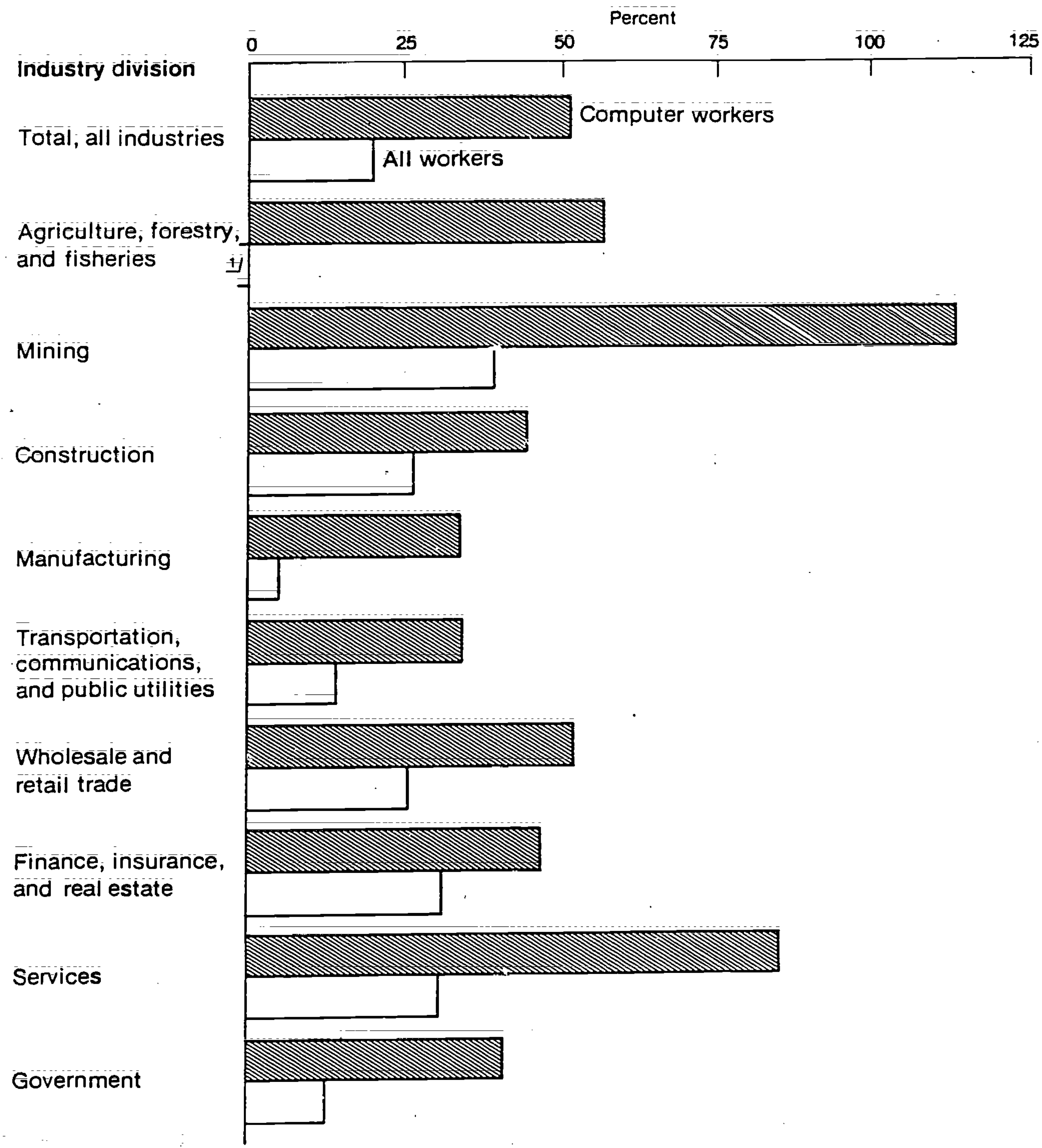
*Developed by Ed Roberts, Program Officer, Mid-Atlantic Center for Race Equity.

Chart 2. Distribution of computer workers by occupation, 1970 and 1980



Source: Bureau of Labor Statistics.

Chart 3. Percent change in employment of computer workers and all workers by industry division, 1970-78



1/ Decrease of less than 0.05 percent.

Source: Bureau of Labor Statistics.

operators are at the lower end of the pay scale and are classified by the Department of Labor as clerical occupations. These lower paying occupational categories have a higher percentage of women and blacks. In 1981, of the 564,000 computer and peripheral equipment operators, 63.8% were women and 15.8% were black. There were 248,000 keypunch operators employed in 1981; 93.5% of them were women and 19.4% were black. In addition, there has been a decline of approximately 40,000 keypunch operator jobs in the 10 years from 1972 - 1981. (See charts 1 & 2.) This decline is expected to continue through the 80's.

While the number of blacks and women employed in higher paying computer-related occupations has increased, they have not kept pace with their representation in the total work force. In 1972, blacks were 10.6% of the total work force but held 5.4% of the computer programmer and systems analyst jobs and 4.4% of the computer service technician jobs. In 1982 blacks were 11.6% of the total labor force. While they were 10.4% of the programmers they were only 8.0% of the systems analysts and 8.0% of the computer service technicians. (See chart 1.)

For women, the disparity between their representation in the labor force and representation in the higher paying computer-related jobs was even greater. In 1972 women were 38.0% of the labor force but were only 19.9% of the programmers, 10.8% of the systems analysts and 2.2% of the computer service technicians. By 1982, women increased their representation in the total labor force to 42.8% but were 29.4% of the programmers, 25.8% of the systems analysts and 7.0% of the computer service technicians. (See chart 1.)

It is projected that the increase in computer use and the accompanying increase in computer-related jobs will continue into the next decade. Projections for the decade 1980-1990 have been released by the Division of Occupational Outlook, United States Department of Labor. Computer-related occupations which are predicted to increase markedly are computer and peripheral equipment operators, computer programmers, computer systems analysts and computer service technicians. (See chart 4.)

CHART 4: PROJECTED CHANGE OF COMPUTER OCCUPATIONS
1980 - 1990

	% Change (High and Low Projections)
Total All Occupations	17 - 25
Computer Programmers	49 - 60
Systems Analysts	68 - 80
Computer Service Technicians	93 - 112
Computer and Peripheral Equipment Operators	66 - 77
Key Punch Operators	9 - 3

Source: U.S. Department of Labor

CHART 5. Percentage of degrees conferred by institutions of higher education, by racial/ethnic group, major field of study, and sex of student: United States 1980-81 [1]

	BACHELOR'S DEGREE				MASTER'S DEGREE				DOCTORAL DEGREE			
study and sex of student	Total	White non-Hispanic	Black non-Hispanic	Hispanic	Total	White non-Hispanic	Black non-Hispanic	Hispanic	Total	White non-Hispanic	Black non-Hispanic	Hispanic
....	(934,800)	86.4	6.5	2.4	(294,183)	82.0	5.9	2.2	(32,839)	78.9	3.9	1.4
....	50.3	43.5	2.7	1.2	49.6	39.3	2.1	1.1	[illegible]	52.8	2.2	0.9
....	49.8	43.0	3.9	1.2	50.5	42.8	3.8	1.2	31.2	26.2	1.8	0.6
formation sciences:												
....	(15,120)	83.1	5.2	2.0	(4,143)	68.1	1.7	1.5	(252)	73.1	0.4	--
....	67.5	57.1	2.6	1.3	76.7	52.0	1.3	1.1	90.1	64.3	0.4	--
....	32.6	26.1	2.6	0.8	23.4	16.1	0.5	0.4	10.0	8.8	--	--
....	(74,954)	81.2	3.3	2.0	(16,358)	62.1	1.6	1.7	(2,551)	53.0	1.0	0.9
....	89.8	72.7	2.7	1.8	91.7	56.1	1.4	1.6	96.0	50.8	0.9	0.9
....	10.3	8.6	0.6	0.2	8.4	6.0	0.3	0.2	4.1	2.2	0.1	0.1
....	(11,078)	85.3	5.3	1.7	(2,565)	73.7	2.7	1.6	(728)	69.7	1.3	0.9
....	57.3	49.0	2.5	1.1	65.9	47.3	1.3	1.2	84.4	58.0	0.9	0.6
....	42.8	36.4	2.8	0.7	34.2	26.5	1.4	0.4	15.7	11.7	0.5	0.3
ces:												
....	(23,950)	88.7	3.8	1.7	(5,227)	78.8	2.1	1.1	(3,140)	77.9	1.1	0.8
....	75.5	67.4	2.6	1.3	79.3	62.3	1.6	0.9	88.1	68.6	0.9	0.7
....	24.6	21.4	1.3	0.5	20.8	16.5	0.6	0.2	12.0	9.3	0.2	0.1

1 Numbers may not total 100 due to rounding.

Source: National Center for Education Statistics

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In addition to the jobs which are directly involved with computers, personnel in other occupations such as secretaries, accountants, managers and engineers, as well as those in new and emerging occupations will be utilizing computers and will need to become computer literate. This occupational outlook plus the use of the microcomputer in leisure and other personal activities has significant implications for elementary, secondary and higher education in this country.

From its inception education in the United States has been designed to help provide equal opportunities for all. Our schools must provide all of our students with an education that will serve them throughout their lives. With the proliferation of computers and the emergence of the information society it becomes particularly important to train students in math, science and computer education.

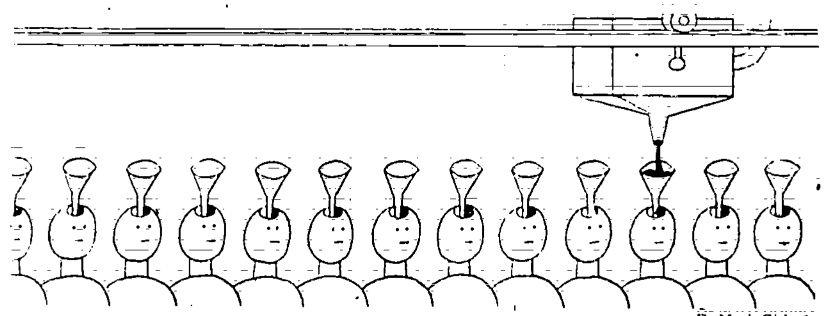
Part of the problem of the underrepresentation of women and blacks in the higher paying computer specialist positions is due to the fact that these are positions that require a college education. Women and blacks are not receiving a high percentage of the college degrees in computer-related fields. (See chart 5).

In summary, there is an underrepresentation of minorities and females in both computer and computer-related occupations as well as in relevant degree programs. To be sure that students are not excluded from computer occupations and related fields, they must have an education which includes extensive elementary and high school preparation in math, science, and computer literacy. This will allow individuals to enter college programs as well as computer-related occupations which do not require a degree but do require a background in math and science.

High-Tech Requires Few Brains

The jobs being created will demand less skill, not more

By Henry M. Levin and Russell W. Rumberger



By Maris Bishofs

MUCH IS BEING MADE of our arrival into the age of high-technology. In Massachusetts last week, President Reagan declared the country is "in a great transition" to high tech, furthing the notion that the nation's economic ills will be cured by our new sweetheart industry as it spawns massive numbers of new jobs requiring sophisticated mathematical and engineering training while reducing or even eliminating opportunities for the unskilled.

Well, the evidence suggests it isn't going to work that way.

High tech is neither the place where most new jobs will be found nor will high tech require a vast upgrading of the skills of the American labor force. To the contrary, the expansion of the lowest-skill jobs in the American economy will vastly outstrip the growth of high-technology ones. And the proliferation of high-technology industries and their products is far more likely to reduce the skill requirements for jobs in the U.S. economy than to upgrade them.

Last year the Labor Department did project that in the '80s, jobs for computer programmers would grow between 74 and 148 percent while overall job growth would only be 22 percent.

But the percentages are misleading. The total number of new jobs for computer programmers is expected to be 150,000. Some 1.3 million new jobs are projected for janitors, nurses' aides and orderlies. That's nine unskilled jobs in these categories alone for every computer programmer. In fact, no high-tech job even makes the Labor Department's top 20 in terms of total numbers of jobs added to the U.S. economy.

New jobs for data-processing-machine mechanics will increase 148 percent, the fastest growing job category. But that large gain translates into an increase of less than 100,000 new jobs, while 800,000 new jobs are projected for fast-food workers and kitchen helpers alone.

Of course, occasional shortages of skilled workers will arise in particular occupations and industries as they have occurred historically. Both the economy and educational system will have to make specific adjustments to alleviate them. But that is hardly the general shortage of skilled workers projected by those who have exaggerated the effects of high-tech.

Neither will the high-tech transformation of existing jobs create demands for increasingly sophisticated work skills. Secretaries will work with word processing equipment; bookkeepers will use computerized, financial spread sheets; purchasing and inventory clerks will apply computerized record systems; mechanics will use diagnostic equipment employing minicomputers; telephone operators will rely on computerized directories.

But there is little evidence that these jobs will require workers with more sophisticated skills. To the contrary, studies suggest that the new technologies provide opportunities to further simplify and routinize work tasks and to reduce the opportunities for worker individuality and judgement.

In such diverse areas as office work, data processing, drafting, wholesale and retail trade, and computer programming, microcomputers are making it possible to utilize persons with lower skills to perform highly sophisticated functions.

Using computers does not necessarily require computer skills. For example, the new generation of office computers is specifically designed so that "no special computer skills are needed." The latest word processors can even correct typing errors automatically by the use of electronic dictionaries, so letter-perfect typing and strong spelling skills are no longer required.

As computer languages have become more "user-friendly" and sophisticated software has become available for a large variety of tasks, many computer programming positions have been eliminated or downgraded in terms of their skill requirements.

In fact, the use of sophisticated equipment often means that the worker requires less sophisticated skills. Today's Ford Escort is far more sophisticated than the Model T of 50 years ago. Yet it is far easier to drive today's vehicle. Computers are far more sopisticated today than they were 10 or 20 years ago. Yet the average programming task is considerably less demanding than it was when there was the need to reprogram plugboards and work in machine languages.

Workers will need to learn different skills rather than more demanding ones. Certainly word processing is different in some respects from typing. However the new skills needed can be acquired through on-the-job training. An expanded foundation in science, mathematics, and computer programming is hardly necessary.

We see an entirely different set of problems arising from high tech than is popularly assumed. Not only will the economy create more low-skill jobs than high, it is possible that high tech will eliminate far more jobs than it will create. For example, experts suggest that the use of computer-assisted design (CAD) software may eliminate a majority of the 300,000 drafters in the U.S.

If the future of work is being written in Silicon Valley, the danger signs are already evident. Although there are clearly some high-level executives, programmers, and engineers who are stimulated by their jobs in the Valley, most workers in these industries are clerical employes, assembly workers, and low-level technicians the challenges of whose labor may leave something to desired.

A recent front-page story in The San Jose Mercury estimated that a third of all workers in the Valley are involved in drugs and alcohol and that drugs are largely responsible for thefts on the job, accidents and a decrease in productivity and quality.

It is time that we take a clearer look at the job implications of high technology, rather than blindly accepting the folk wisdom on the subject.

Henry M. Levin is director of, and Russell Rumberger a research economist at, the Institute for Research on Educational Finance and Governance at Stanford University.

WASHINGTON POST -- January 30, 1983

APPENDIX

Software Reviews

Courseware Report Card
150 West Carob Street
Compton, CA 90220
(213) 637-2131

This review of educational microcomputer software is published in two editions: Elementary (K-6) and Secondary. Each issue contains about 20 reviews, covering: Apple, Radio Shack, Atari, Commodore, and Texas Instruments-related educational software. Descriptions of each program include a summary evaluation that rates specific aspects of the programs from "A" to "F". *Courseware Report Card* subscriptions are $49.95 for five issues during the school year.

Journal of Courseware Review
The Apple Education Foundation
20525 Mariani Avenue
Cupertino, CA 95014
(408) 973-2105

The Foundation's Educational Program Evaluation Center (EPEC) publishes this journal tri-annually, featuring reviews of commercial software for Apple microcomputers. Cataloguing and source information, and sample screen displays are provided for each software package reviewed. It is available from microcomputer dealers.

MACUL Journal
c/o Lary Smith
Wayne County ISD
PO Box 807
Wayne, MI 48184

The Journal of the Michigan Association for Computer Users in Learning (see Local Resources: Michigan) is published occasionally and is included in the MACUL membership. The Winter 1981 issue of *MACUL Journal* was a special report consisting of 143 educational software reviews. Most of the software reviewed is for Apple systems, although TRS-80, PET, Atari, and Texas Instruments software is included.

Microcomputer Courseware/ Microprocessor Games, EPIE Materials Report 98/99m.
from: EPIE Institute
Box 620
Stony Brook, NY 11790
(516) 246-8668

This report includes reviews of six comprehensive, commercial educational software packages. The contents, methodology, and use considerations are evaluated for each package. Recommendations and criticisms of the software are included. The report also includes critical evaluations of microprocessor games.

Peelings II
PO Box 188
Las Cruces, NM 88004
(505) 526 8364

Peelings II, published nine times a year, evaluates Apple II software and hardware. It describes and critically examines commercially available programs including ease of use, documentation, and errors. Programs are rated by letter grades. *Peelings II* will have a regular education section. Subscriptions are $21.

School Microware Reviews
Dresden Associates
PO Box 246
Dresden, ME 04342
(207) 737-4466

Produced by the publishers of the *School Microware Directory (see Software Directories)*, this periodical contains indepth user evaluations of software programs for Apple, Atari, PET, and TRS-80 microcomputer systems. *School Microware Reviews* encourages teachers to submit courseware evaluations.

Software Review
Meckler Publishing
520 Riverside Avenue
Westport, CT 06880
(203) 226-6967

A review of computer programs for library and educational applications, *Software Reviews* also contains articles on software concepts and evaluation. The review is published quarterly.

TALMIS Courseware Ratings
115 North Oak Park Avenue
Oak Park, IL 60301
(312) 848-4000

TALMIS, an information service for the educational software industry, asks panels of primary and secondary school teachers to evaluate and rate commercial educational software. TALMIS regularly publishes information from these surveys, and the first educational software ratings are available. A newsletter summarizing this information is available free of charge to participants in the survey, and to others for $6.95 per year.

From: 1983 Classroom Computer News Directory of Educational Computing Resources published by Intentional Educations, Inc., 341 Mt. Auburn Street, Watertown, MA 02172.

Software Clearinghouses

Conduit
PO Box 388
Iowa City, IA 52244
(319) 355-5789

Conduit both reviews and distributes software. Although primarily concerned with software for higher education, some of the programs reviewed and distributed are appropriate for advanced high school math and science classes. Conduit has a project to convert mainframe and minicomputer programs for use on mircrocomputers, although only several dozen as yet have been completed. Its authors' guide has been used as a model for establishing guidelines for developing and evaluating software. Conduit also publishes a biannual, *Pipeline*, *(see Periodicals)*.

Microcomputer Education Applications Network (MEAN)
256 North Washington Street
Falls Church, VA 22046
(703) 536-2310

MEAN helps educators develop and sell software and provides information on educational microcomputer applications. MEAN encourages software development in areas delineated by its members. For example, MSMS (Modularized Student Management System) reduces staff time in maintaining individual student files in special education. SP ED READ and SP ED MATH software provide assistance to teachers developing CAI for students having difficulties with reading and math. These programs are now available. Members of MEAN receive the *MEAN Brief* newsletter which provides information on other software sources, industry news, and a subscriber exchange of particular microcomputer applications and requests. MEAN also helps local districts and state agencies develop specific educational computing programs.

Microcomputer Software and Information for Teachers (MicroSIFT)
Northwest Regional Educational Laboratory
300 SW 6th Avenue
Portland, OR 97204
(503) 248-6800

MicroSIFT is a clearinghouse for descriptive and evaluative information about microcomputer-based software packages for education. It has established procedures for evaluating instructional packages using criteria in the areas of content, instructional quality and technical quality. The information is disseminated in print form through state and local education agencies and some commercial and professional periodicals. It is also available as a database on the system of Bibliographic Retrieval Services *(see Databases)*. Technical assistance to educational agencies is available under contract.

SOFTSWAP
c/o Ann Lathrop
San Mateo County Office of Education
333 Main Street
Redwood City, CA 94063
(415) 363-5472

SOFTSWAP, a joint project of the Microcomputer Center of the San Mateo County Office of Education and Computer-Using Educators (CUE) (see *Resource Centers and Local Resources: California*), receives donations of public-domain educational software, evaluates and refines the programs. The programs are available free of charge to educators who copy them onto their own disks at the Microcomputer Center. SOFTSWAP also operates as a software exchange. Any educator who contributes an original program on a disk may request any SOFTSWAP disk in exchange. In addition, SOFTSWAP sells completed disks (five to thirty programs per disk) for a nominal fee. More than 300 public-domain programs are available on some fifty disks, for Apple, Atari, Compucolor, TRS-80, and PET microcomputers. For a complete catalogue and ordering information, send $1 to SOFTSWAP.

INFORMATION RESOURCES ON. . .

MICROCOMPUTERS: A SAMPLING OF THE ERIC DATABASE

Citations in this bibliography were selected from the Educational Resources Information Center (ERIC) indexes Resources in Education and the Current Index to Journals in Education for 1981 and 1982. Subject headings used to locate them were Microcomputers and/or Computer Literacy.

Overview

Feurzeig, W., et al. Microcomputers in education. Report no. 4798. Cambridge, MA: Bolt, Beranek and Newman, 1981. (ERIC Document Reproduction Service No. ED 208 901; MF-$.91/PC-$8.60)

A brief review of the history of computer assisted instruction and discussion of the current and potential roles of microcomputers in education introduce this review of the capabilities of state-of-the-art microcomputers and currently available software for them, and some speculations about future trends and developments.

Frederick, F. J. Guide to microcomputers. Washington, DC: Association for Educational Communications and Technology; Syracuse, NY: ERIC Clearinghouse on Information Resources, 1980. (ERIC Document Reproduction Service No. ED 192 818; MF-$.91/PC-$11.90; also available in PC from AECT Publication Sales, 1126 16th Street, NW, Washington, DC 20036 for $11.50/non-members; $9.50/members)

A comprehensive guide to microcomputers which discusses their general nature; computer languages; operating and compatible systems; special applications and accessories; service and maintenance; computer assisted and managed instruction; graphics; time and resource sharing; potential instructional and media center applications; and an extensive resource list.

Gleason, G. T. Microcomputers in education: The state of the art. Educational Technology, March 1981, 21(3), 7-18. (Available UMI: EJ 244 284)

An overview of instructional applications of CAI and microcomputer applications which discusses current developments in hardware and software, the need for independent review and evaluation of programs, the growing importance of computer literacy, and projections for the future.

Harris, D., & Nelson-Heern, L. (Eds.) Proceedings of the NECC 1981. National Educational Computing Conference (3rd, North Texas State University, Denton, Texas, June 17-19, 1981). Iowa City: University of Iowa, Weeg Computing Center, 1981. (ERIC Document Reproduction Service No. ED 207 526; MF-$.91/PC-$10.00 from Computer Science Department, University of Iowa, Iowa City, IA 52242)

Includes texts of more than 50 papers presented at a conference organized to present in one forum all major work regarding computers in education in the United States. Topics covered include simulations, videodisc projects, administration, computer literacy, business, higher education, humanities, science, social science, computer science, preschool/elementary applications, graphics, mathematics, engineering, and health education.

Computer Literacy

Beck, J. J., Jr. Computer literacy for elementary and secondary teachers. Paper presented at the Annual Meeting of the Texas Association for Supervision and Curriculum Development (Houston, TX, November 5, 1980). (ERIC Document Reproduction Service No. ED 208 868; MF-$.91/PC-$2.00)

Examines procedures for designing the first stage of a systematic plan to incorporate computer technologies in elementary and secondary schools. Based on the rationale that a computer literate faculty must be available to make decisions on effective computer use, the paper discusses roles that teachers and computers will play in educating students in the 21st century.

Kirchner, A. M. One state's approach to computer literacy. Technological Horizons in Education, May 1981, 8(4), 43-44. (Available UMI: EJ 252 831)

Reports on a pilot project to introduce a beginning course in computer literacy for elementary through post-secondary students in Pennsylvania. Includes descriptions of course rationale and teacher training.

Mayer, R. E. Contributions of cognitive science and related research on learning to the design of computer literacy curricula. Report no. 81-1. Series in learning and cognition. Santa Barbara, CA: University of California, Dept. of Psychology, 1980. (ERIC Document Reproduction Service No. ED 207 551; MF-$.91/PC-$3.65)

ERIC Clearinghouse on Information Resources, Syracuse University
School of Education, Syracuse, N.Y. 13210, (315) 423-3640

Reviews the research on techniques for increasing the novice's understanding of computers and programming, and considers the potential usefulness of five tentative recommendations pertinent to the design of computer literacy curricula. A bibliography of 59 references is included.

Wright, A. Developing standards and norms for computer literacy. Discussion paper 06/80. Victoria, British Columbia: Dept. of Education; JEM Research, 1980. (ERIC Document Reproduction Service No. ED 208 847; MF-$.91/PC-$5.30)

Provides educators with a general perspective on computer literacy, then defines and discusses it in terms of specific experiences or desired outcomes. The Computer Literacy Awareness Assessment conducted by the Minnesota Educational Computing Consortium (MECC) is examined in depth, including its development, purposes, and structure.

Hardware

Aiken, R. M. The Golden Rule and Ten Commandments of computer-based education (CBE). Technological Horizons in Education, March 1981, 8(3), 39-42. (Available UMI: EJ 252 824)

Examines ten factors that people selecting and using computers in the classroom should consider if the system is to be most effectively utilized as a teaching tool. Topics include personnel, materials, services, and equipment.

Douglas, S., & Neights, G. Microcomputer reference: A guide to microcomputers. Microcomputers in education series. Harrisburg: Pennsylvania State Dept. of Education, 1980. (ERIC Document Reproduction Service No. ED 205 203; MF-$.91/PC-$3.65)

A guide for educational practitioners considering the purchase of a microcomputer which discusses basic information about computers and criteria to use in conducting a needs assessment and in evaluating various microcomputers in relation to those needs.

Willis, J., & Miller, M. Computers for everybody. Beaverton, OR: Dilithium Press, 1981. (ERIC Document Reproduction Service No. ED 208 869; MF-$.91/PC-$4.95 from Dilithium Press, PO Box 606, Beaverton, OR 97075)

Includes a guide to buying a microcomputer and advice on using it in business applications, and describes the more popular computers on the market, common programming languages, and how computers work. Bibliographies and directories, book publishers, and magazines are listed for further reading.

Software

Douglas, S., & Neights, G. Instructional software selection: A guide to instructional microcomputer software. Micrcomputers in education series. Harrisburg: Pennsylvania State Dept. of Education. (ERIC Document Reproduction Service No. ED 205 201; MF-$.91/PC-$3.65)

A guide for evaluating microcomputer instructional software which includes a hardware/software interface analysis sheet and an instructional software evaluation form for use in judging specific objectives, grade level, validation data, correlation data, instructional strategies employed in the software, and instructional design features.

Evaluater's guide for microcomputer-based instructional packages. Portland, OR: Northwest Regional Educational Lab, 1981. (ERIC Document Reproduction Service No. ED 206 330; MF-$.91/PC-$5.30)

Developed by MicroSIFT, a clearinghouse for microcomputer-based educational software and courseware, this guide provides background information to aid teachers and other educators in evaluating available microcomputer courseware. The evaluation process is described, which includes sifting/screening, package description, and courseware evaluation. Forms are provided for the second and third phases, together with explanations of information needed and discussions of factors to be considered in completing the forms.

Forman, D., et al. Reference manual for the instructional use of microcomputers. Volume I (Release II). Victoria, British Columbia: JEM Research, 1981. (ERIC Document Reproduction Service No. ED 208 849; MF-$1.86/PC-$58.10; also available in PC from JEM Research, Discovery Park, PO Box 1700, Victoria, B.C. V5W 2Y2 for $75.00)

A manual intended to provide educators with information and guidelines for locating, selecting, and purchasing commercially available courseware for the Apple II microcomputer. An annotated bibliography of microcomputer journals, magazines, and a list of selected compatible accessories and expansion options for the Apple II are also provided.

Lathrop, A., & Goodson, B. How to start a software exchange. Recreational Computing, September-October 1981, 10(2), 24-26. (EJ 250 679)

Describes the microcomputer display center and SOFTSWAP program developed by the San Mateo County (California) Office of Education and the Computer Using Educators' group. SOFTSWAP disseminates teacher-produced, public domain courseware and is beginning evaluations of commercial products.

School microware: A directory of educational software. Over 500 programs/packages for APPLE, PET, TRS-80. Dresden, ME: Dresden Associates, 1980. (ERIC Document Reproduction Service No. ED 196 431; MF-$.91/PC-$14.00 from Dresden Associates, PO Box 246, Dresden, ME 04342)

A preliminary directory representing offerings of 45 software suppliers and information about instructional software available for three microcomputers widely used in schools. Selections are geared toward a wide variety of users, including school planners, teachers, media center personnel, schools of education, and home computer users.

Elementary/Secondary Education

Goddard, W. P. Implications of MECC for B.C. school computer development. Discussion paper 11/79. JEM project no. 0610. Victoria, British Columbia: Dept. of Education; JEM Research, 1980. (ERIC Document Reproduction Service No. ED 208 844; MF-$.91/PC-$2.00)

Introduces a rationale and format for the introduction of microcomputers into the classrooms of British Columbia on a cost-effective basis, presents the activities of the Minnesota Educational Computing Consortium (MECC), and describes how MECC's experience might be adapted to the needs of British Columbia.

Prentice, L., & Beckelman, L. Classroom computer news. Instructor, October 1981, 91(3), 85-90; 94; 96-98. (Available UMI: EJ 250 729)

The editors of Classroom Computer News prepared this compendium of news and tips for using computers in the classroom. Topics include computer literacy, the benefits of classroom computer use, programming individualized education programs, selecting courseware, the basics of microprocessors, and new products.

Stutzman, C. R. Computer supported instruction in California elementary and secondary schools. A status report. Paper presented at the Annual Fresno Research Symposium (2nd, Fresno, CA, April 24, 1981). (ERIC Document Reproduction Service No. ED 206 304; MF-$.91/PC-$3.65)

A survey instrument was sent to superintendents of each school district in California in June 1980 to gather information about the uses of computers in instruction in the state's public elementary and secondary schools. Findings of the study are reported.

Wright, A. Microcomputers in the schools: New directions for British Columbia. Discussion paper number 05/80. Victoria, British Columbia: Dept. of Education, Information Service; JEM Research, 1980. (ERIC Document Reproduction Service No. ED 208 846; MF-$.91/PC-$3.65)

Outlines plans for educational use of microcomputers in British Columbia, indicates long-term possibilities, and describes current project activities. Hardware is discussed in terms of usage, context, location, and educational level. The approach to software includes development of a standards manual for courseware evaluation, modification of courseware by JEM Research, new program development, and teachers developing their own programs.

Specific Applications

Dugdale, S. Green Globs: A microcomputer application for graphing of equations. Urbana, IL: University of Illinois, Computer-Based Education Research Laboratory, 1981. (ERIC Document Reproduction Service No. ED 208 876; MF-$.91/PC-$2.00)

Outlines the development of an activity that uses the computer's unique capabilities to provide students with a meaningful and motivating experience with the graphing of equations. Highlights of classroom use of Green Globs are provided.

Hannaford, A., & Sloane, E. Microcomputers: Powerful learning tools with proper programming. Teaching Exceptional Children, November 1981, 14(2), 54-57. (EJ 252 308)

The potential uses of microcomputers in special education are considered. Cautions are noted regarding selection of software which will meet learner/teacher needs, possess instructional integrity, and be technically adequate and usable.

Haugo, J. E. Management applications of the microcomputer: Promises and pitfall. AEDS Journal, Summer 1981, 14(4), 182-188. (EJ 251 012)

Examines advantages and disadvantages of using microcomputers in educational management, e.g., handling financial, personnel, or student data. Microcomputers are compared to large computers and manual recordkeeping in school administration.

Rowbotham, N. Using a microcomputer in science teaching. School Science Review, September 1981, 63(222), 70-77. (Available UMI: EJ 254 279)

Explores several options and advantages of using microcomputers in science teaching. Describes programs for calculating pH, Maxwell-Boltzman distribution of velocities in a gas, atomic orbitals, and lattice energies. Also suggests use of microcomputers in the areas of simulations, scoring tests, and controlling stock.

Vickery, C. A. Personal experiences: Using microcomputers in a junior high school high-potential program. Paper presented at the Annual Meeting of the International Reading Association (26th, New Orleans, LA, April 27-May 1, 1981). (ERIC Document Reproduction Service No. ED 208 860; MF-$.91/PC-$3.65)

A school district's involvement in use of microcomputers and one teacher's experiences at the junior high level are described. Strategies for initiating teacher involvement and an analysis of microcomputer applications in an English class, in writing a school newspaper, and in a program for the academically gifted are presented.

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APPLE EDUCATOR'S NEWSLETTER
9525 Lucerne Street
Ventura, CA 93004

This bimonthly newsletter is published by Apple for the teacher. The California-based organization of elementary and secondary school teachers is established to share information and to develop educational software for the Apple. The newsletter reports on projects that are often not covered elsewhere. It also notes commercial educational software and computer publication releases. It is available for $15 per year.

CLASSROOM COMPUTER NEWS
Intentional Educations, Inc.
341 Mt. Auburn Street
Watertown, MA 02172
(617) 923-7707

Classroom Computer News, published 6 times during the school year, links computer-based learning with traditional classroom instruction. Regular features include a section on teacher-developed classroom applications, articles with original programs, profiles of computer-involved educators and a Viewpoint column presenting differing points of view on educational computing issues. Also in CCN is a review section focusing on software, but including hardware and literature, and Treehouse, written to help middle school children understand computers. An Administration column suggests uses for computers in school organization and a media section describes various approaches to cataloguing and retrieving computer-based information. Manufacturers information on new products and a calendar of events in the educational computing world appear in each issue. Subscriptions are $16.

CLOSING THE GAP
Route 2, Box 39
Henderson, MN 56044
(612) 665-6573

This new publication is dedicated to exploring the uses of computers with the handicapped and special education students. The articles focus on projects and products which are immediately applicable and contact information is regularly provided. Subscriptions to this bimonthly are $15.

CMC NEWS
ES Task Group of ACM Computers and the Media Center
515 Oak Street North
Cannon Falls, MN 55009
(507) 263-3711

This newsletter describes uses of computers in libraries and media centers. Task group members' addresses are regularly listed in the newsletter. CMC Newsletter is published 3 times during the school year and is available for $3 prepaid.

COMPUTER TIME
Computer Club
O'Leary Junior High School
2350 Elizabeth Blvd.
Twin Falls, ID 83301

This newsletter is produced by students and educators in two junior high schools in Idaho. Dedicated to the growth of computer programming in schools, Computer Time contains programs, helpful programming hints, and notices of computing resources and publications. 6 issues a year are available for $3.

THE COMPUTING TEACHER
Department of Computer and Information Science
University of Oregon
Eugene, OR 97403
(503) 686-4429

The Computing Teacher publishes solid general and technical articles on the instructional use of computers. It is offered to members of the International Council for Computers in Education and emphasizes precollege education and teacher training. Articles are written by educators in the field. It also includes programming corrections, suggestions, and computing problems. Software and book reviews, news items on conferences, projects and resource centers, and technological developments in computers are regularly printed. 1 year's membership is $16.50 and includes 9 issues of The Computing Teacher.

C.U.E. NEWSLETTER
P.O.Box 18457
San Jose, CA 95158

The California-based group, Computer Using Educators, publish this useful newsletter approximately 6 times during the school year. Information on upcoming conferences and reviews of books and software are regularly reported. C.U.E. membership is $6 (institutions $20) and includes the newsletter.

EDUCATIONAL COMPUTER MAGAZINE
P.O. Box 535
Cupertino, CA 95015
(408) 252-3224

This bimonthly magazine for educators using computers in the classroom examines possible benefits and problems of instructional computing. Articles include reports from conferences and ongoing projects. Each issue includes book and educational software reviews and a calendar of upcoming conferences. Subscriptions are $15.

EDUCATIONAL TECHNOLOGY
140 Sylvan Avenue
Englewood Cliffs, NJ 07632
(201) 871-4007

This long-established monthly is oriented toward general educational use of technology. Each issue has columns on educational computing and media news for professionals in these areas. Periodic special issues offer a collection of articles examining specific facets of classroom use of technology including detailed book, materials, and product reviews. Educational Technology draws attention to worthwhile commercially available software in its product review pages. Columnists comment on specific developments in educational technology while theoretical articles discuss the whys of educational computer applications. 1 year subscriptions are $49.

ELECTRONIC EDUCATION
Electronic Communications, Inc.
Suite 220
1311 Executive Center Drive
Tallahassee, FL 32301
(904) 878-4178

Feature articles provide general introductions and nontechnical discussion of issues in the educational use of computers. News briefs discuss applications of educational technology. The magazine contains descriptive reviews of computer systems and instructional packages. Subscriptions are $15 per year.

ELECTRONIC LEARNING
Scholastic, Inc.
902 Sylvan Avenue
Box 2001
Englewood Cliffs, NJ 07632

This publication provides nontechnical introductions to the educational applications of microcomputers and other electronic learning aids, such as the video cassette recorder, the videodisc player, and cable TV. Feature articles include first-person reports on integrating technology into the traditional curricula, reports on various aspects of educational technology, such as disc-sharing or authoring languages, and buyer's guides to hardware and software. Regular departments include news columns, reporting items of interest to educators and industry leaders, funding ideas and sources, an inservice column, an opinion page, and a software review section, in which commercial programs are reviewed by both a classroom teacher and a content specialist or school administrator. 1 year subscription (8 issues) is $15.

ETC
Far West Laboratory
1855 Folson Street
San Francisco, CA 94103

The Educational Technology & Communication (ETC) Newsletter is published monthly by the Far West Laboratory of Educational Research and Development. ETC includes information on computing resources, upcoming conferences, and new publications. Classroom applications of computers are described and a column answering readers' questions is provided. 1 year subscription costs $36.

FOLLKLORE
Friends of LISP, Logo, and Kids (FOLLK)
c/o Chris Lincoln
436 Arallo Drive
San Francisco, CA 94132
(415) 239-2519

FOLLK, a member organization of Young People's Logo Association, is a group promoting and sharing information on artificial intelligence. It has produced its own software, including a graphics editor and other utilities for Apple Logo, and holds hands-on workshops and summer day camps. FOLLK seeks to network educational users as well as educational institutions to share resource materials and programs. FOLLKlore is published quarterly.

INSTRUCTIONAL INNOVATOR
AECT
1126 Sixteenth Street NW
Washington, DC 20036

This publication, issued by the Association for Educational Communications and Technology, features articles on new aspects of educational technology. It monitors educational computing and publishes special issues on microcomputers in education. Hardware is described in articles and in a new products section. It also announces bibliographic searches and reports available from the ERIC database. 1 year subscriptions to nonmembers are $24.

INTERFACE: THE COMPUTER EDUCATION QUARTERLY
Stehpen Mitchell, Publisher
915 River Street
Santa Cruz, CA 95060
(408) 425-3851

This quarterly journal for computer science and data processing professionals includes articles and opinion columns on instructional uses of computers. Book reviews and programming tips are also included. Subscriptions are $11.

MICROCOMPUTERS IN EDUCATION
Queue, Inc.
5 Chapel Hill Drive
Fairfield, CT 06432
(203) 335-0908

Queue, the software distributors, publish this monthly newsletter which focuses on the commercial educational software marketplace. Besides describing new educational programs available from Queue, the newsletter regularly reviews software and also summarizes reviews from other magazines and notes where the reviews first appeared. Microcomputers in Education regularly carries announcements of new products, publications, workshops, and projects. It is available for $33 per year.

NEWSLETTER OF THE NATIONAL CONSORTIUM ON USES OF COMPUTERS IN THE MATH. SCIENCES EDUCATION
014 Memorial Hall
University of Delaware
Newark, DE 19711

Available free of charge from the Math Special Interest Group of ADCIS, this newsletter is intended for educators at all levels, elementary through post-secondary. Recent issues have described computer use in elementary and middle school mathematics classes.

PIPELINE
P.O. Box 388
Iowa City, IA 52244
(319) 353-5789

Pipeline, published twice yearly by Conduit, offers ideas for computer use in education. Each issue contains descriptions and order forms for Conduit's latest reviewed and tested materials, some of which are appropriate for secondary school curricula. Articles integrate discussions of educational technology, pedagogy, and curriculum content, and are a useful resource for educators.

SCHOOL MICROCOMPUTER BULLETIN
Learning Publications, Inc.
Box 1326
Holmes Beach, FL 33509

This new newsletter reports on microcomputing trends and educational computing applications. The bulletin plans to detail computing concepts and specific commercial packages in a langauge that is addressed specifically to educators. A cross-referenced index is included. 1 year subscription (24 issues) is $48.

SMALL COMPUTERS IN LIBRARIES
Graduate Library School
University of Arizona
1515 East First Street
Tucson, AZ 85719
(602) 626-3566

This newsletter discusses the internal and public access library applications of microcomputers. It is intended as a clearinghouse and includes glossaries, tutorial articles, and reports on uses of computer library management systems.
Subscriptions are $20 per year (published monthly).

TANGENTS
16 Lewis Street
New Haven, CT 06513
(203) 773-3279

This is a new children's magazine about computers. Articles, written both by children and adults, encourage creativity, problemsolving, and programming skills. The 64-page bimonthly is published in a special child-sized format.

T.H.E. JOURNAL
P.O. Box 992
Acton, MA 01720
(617) 263-3607

Technological Horizons in Education (T.H.E.) Journal discusses both the theoretical and practical aspects of educational technology. Reviews of software, projects, and publications are linked in an inquiry service card so that additional information can be obtained from the manufacturer. Material included is geared toward promoting educational technology. However, much state of the art information can be gleaned from the magazine. T.H.E. Journal is published 6 times a year and is available free on a limited basis to qualified educators.

TURTLE TALK
Harvest Publishing
118 Magazine Street
Cambridge, MA 02139
(617) 547-3289

This new bimonthly newsletter is designed to promote interest in Logo and to provide a forum for the exchange of information about Logo. Regular features include "The Logo Workbench", an insert on the applications of Logo in special education, and "The Spotlight Series" which will cover ongoing uses of Logo in specific school districts. Subscriptions are $12 for 1 year and $3 for a sample copy.

JOURNAL OF COMPUTER BASED INSTRUCTION
ADCIS
409 Miller Hall
Western Washington University
Bellingham, WA 98225

This is a professional quarterly of theoretical articles, lectures, and reports. The professional reports discuss findings of research and surveys in the field of computer-based instruction in elementary and secondary school systems, colleges, business, military, and government agencies.

JOURNAL OF COMPUTERS IN MATHEMATICS AND SCIENCE TEACHING
Association for Computers in Mathematics and Science Teaching
Box 4455
Austin, TX 78765
(512) 258-8083

This quarterly features descriptions of computer use in math and science instruction, tutorials, and research studies. The journal reviews software, lists available math and science software, announces conferences and workshops, and presents bibliographies and book reivews. Membership in the association ($15 per year) includes the journal.

MICRO....PUBLICATIONS IN REVIEW
Vogeler Publishing, Inc.
P.O.Box 489
Arlington Heights, IL 60006
(312) 255-6385

Micro....Publications in Review reprints the table of contents from the latest issues of about 70 journals, magazines, and newsletters dealing with small computers. The Review includes a subject index divided into 26 major disciplines and a further index of smaller categories. Publishers' addresses are also listed.

MICROCOMPUTER DIGEST
103 Bridge Avenue
Bay Head, NJ 08742

This newsletter provides information for teachers and educational administrators. Hardware amd software is explained and compared, while new technologies and applications are also explained for educators. It is published monthly (except August) at $60 per year.

GLOSSARY

A version of this glossary was originally compiled by Robert D. Woolley and Jane Erikson in June, 1979. It has since been modified several times. Original terminology was taken from a wide variety of sources. Many of the terms are common to all types of computer systems, while some are uniquely related to microcomputers. Selection of terms is based on the type of language educators are most likely to encounter when dealing with vendors, programmers and others involved in computer technology.

Major sources used with this compilation include the _Byte Shopper_, _Using BASIC in the Classroom_, _APPLE: The Personal Computer Magazine and Catalog_, _Are You Computer Literate?_, _Basic Programming for Computer Literacy_, and a number of microcomputer journal articles. A number of terms were modified or supplied by the original compilers. This glossary is a product of the staff of the Exceptional Child Center, Utah State University, Logan, Utah in 1982.

Access Time: The time required to gain access to needed data. A modern computer can access data from storage very quickly. Examples: from primary storage--less than 1 microsecond; magnetic disk--25-100 millisecond; magnetic tape--50 milliseconds to several minutes. Generally speaking the shorter the access time, the more costly the storage system.

Accumulator (AC): An area of circuitry contained in the CPU for temporarily storing data words accessed out of memory, arithmetic and logical operands, and results of CPU operations.

Address: A number that designates the location of a particular piece of information stored in a memory device.

ALGOL: A computer language designed mainly for programming scientific applications. This is one of the more modern and widely used procedure-level languages.

Algorithm: A finite, step-by-step set of directions guaranteed to solve a particular type of problem. Computers can sometimes carry out some of these steps. Examples are long division, square roots, or others that are studied in mathematics courses. One of the two general categories of procedures studied in computer science.

Alphanumeric: A term describing information that consists of both letters and numbers.

Array: A table of characters. The name of this table called the array name is any legal variable name: A, for example. The array name A is distinct and separate from the simple variable A. e.g. A(25), A(45).

ASCII: American Standard Code for Information Interchange- A standard set of binary codes which represent letters, numbers and symbols.

Assembler: A computer program that takes instructions written in assembly language and converts them into machine language.

Assembly Language: A computer language intermediate between machine language and compiler languages. It allows machine language instructions to be written in simplified form using mnemonics and other standarized abbreviations. These instructions are later converted to a machine language the computer understands. (See Assembler)

Authoring Language: A computer programming language that is specifically designed for writing instructional programs or courseware.

Back-up Diskette: A copy of an original disk that is kept on-hand in case the original copy is destroyed or damaged due to system failure, magnetic fields, over-handling, general wear or unusual circumstances. An insurance policy of sorts.

BASIC: Beginner's All-Purpose Symbolic Instruction Code. A high level conversational programming language that incorporates simple English words and common mathematical procedures. BASIC is available on most microcomputer and timesharing systems cur ntly available.

Baud: Signifies a rate of serial data transfer in bits per second.

Binary: A number system based on powers of 2, and having only two digits: 0 and 1. Operations inside the computer are in binary form (current through a particular circuit is either on or off). Decimal 178 is represented in the computer as binary 10110010. Most computers are based on the binary system.

Booting the Disk: The term used to describe the loading of programs from diskette into the memory of the microcomputer. On the Apple II, this is accomplished by placing the diskette into the disk drive, closing the door and turning the power on. The Apple II system, without the automatic boot feature, requires that you turn on the power and type "PR#6". It then returns to load information from the diskette into the machine.

Branch (jump): A means of departing from the sequence of the main program to another routine or sequence of operations as indicated by a branch instruction whose execution may be dependent on conditions specified.

Bug: An error in program software or a defect in computer hardware that causes malfunction in computer operation.

Bus: A circuit path over which data and/or instructions are transferred throughout the computer. Buses allow for the transmission of information among memory, CPU, and I/O devices. Different bus lines have specific purposes; e.g., data bus, address bus, control bus, etc. S-100 Bus is becoming an industry standard--it means there are 100 connections to circuits.

Byte: A basic unit of information in a computer. One byte is equivalent to one keyboard keystroke. 48K bytes of memory means a capacity of approximately 48,000 letters or numbers of data that can be remembered by the computer.

CAI: Computer Assisted Instruction. A method of using a computer system as a means of presenting individualized instruction materials. In CAI the computer is used as an instructional delivery device.

Catalog: A list of filenames that are located on the diskette. To bring up the "catalog" in BASIC you must type CATALOG and press the return key.

Cathode Ray Tube (CRT): The type of vacuum tube used as the display screen in many computer terminals.

Central Processing Units (CPU): The "brain" of the computer. This part of the computer is responsible for interpreting data and executing instructions.

Character: A letter, digit, punctuation mark, or other sign used to represent information. Computers are designed for the input, storage, manipulation, and output of characters.

Chip: A small piece of silicon with electrical circuits imprinted on it. In computers, this is usually a microprocessor, containing both CPU and main memory systems. (See Integrated Circuit)

Clock: A device that internally synchronizes computer operations.

COBOL (Common Business Oriented Langauge): A high level language heavily oriented to the use of files and record keeping. It replaces operation codes of assembly level languages with a set of powerful "verbs" resembling common English.

Compiler: A computer program (that is, software) that translates a program written in a high-level language such as BASIC, COBOL, or FORTRAN into machine language or an assembler language.

Compiler Language: A language such as BASIC, COBOL, or FORTRAN designed to assist the programmer in writing procedures to solve problems. A single statement in a compiler language usually translates into a sequence of machine language statements. Also called a procedure-level language.

Computer: A device that can input, store, manipulate, and output data. It can automatically follow a program (a detailed step-by-step of directions).

Core Storage: The primary or internal memory of a computer. The word comes from the very small doughnut-shaped iron cores which, at one time, were the most widely used form of primary storage. Now, solid-state devices are often used as primary storage--but may still be mistakenly called core memory.

CPU: (See Central Processing Unit)

Cursor: The small flashing light which let's you know just where you're located on the CRT (cathode ray tube) or television screen.

Data: The information that is processed by a computer.

Data Bank: A comprehensive collection of data.

Data Processing: The computer activity of receiving information, working with it, and producing a desired result.

Debug: To find and correct malfunctions in computer operation or a program (software).

Disk (Disc): A circular piece of material which has a magnetic coating similar to that found on ordinary recording tape. Digital information can be stored magnetically on a disk, much like musical information is stored on a magnetic tape.

Documentation: Material designed to help a user to understand and use a program. Includes stepwise refinements, flowcharts, program listings containing adequate numbers of REM statements, sample computer output, written directions and descriptions, etc.

DOS (Disk Operating System): A computer system which uses disk storage. Also refers to special software routines for driving a disk system.

Driver: A control unit for peripheral device; e.g., a floppy disk drive.

High Resolution Graphics: The visual effects capabilities of the microcomputer which divides the screen into a 280 by 160 plot grid. High resolution graphics give much greater detail than that available in low resolution. The availability of colors is limited to 7 on the Apple II.

Input: Information given to a computer for processing from outside the computer system.

Input Device: Hardware used for putting data into a computer for processing; e.g., a keyboard.

Input/Output (I/O): The hardware used to enter data into and to produce data from a computer system.

I/O: (See Input/Output).

Instruction Set: The repertoire of the instructions a given machine can execute. A major component of a computer's design. The programs of one computer can't run on another computer if the two instruction sets aren't compatible.

Integrated Circuit (IC): A technique whereby many electronic components can be integrated and mass produced on a single chip of silicon.

Interface: (1) A hardware and/or software link used to connect a computer to peripheral equipment. (2) To connect two systems or system components in order to facilitate their interoperation.

Interpreter: A language program translator that recondenses each user-created high-level language instruction into executable binary each time it encounters a user instruction. Interpreters are inefficient and slow translators, but they do permit the user to rapidly modify his program in conversational dialogue with the interpreter.

K: A symbol used to denote a little over a thousand of something. "8K bytes of memory" means the same as "about 8000 memory cells." One K equals exactly 1024. Typically, an 8-bit microprocessor is capable of addressing 64K memory cells.

Keyboard Terminal: A computer input and output device with a typewriter-like keyboard and a display mechanism (paper or CRT).

Language: A set of computer words and syntax used in giving the computer a set of instructions to perform. Some common computer languages are BASIC, COBOL, FORTRAN, ALGOL.

LED: Light-emitting diode. LED displays are often used as digital output devices because of their low weight, cost and size.

Light Pen: A pen-shaped device for direct input to a computer by passing the pen over data to be transmitted, also sometimes called a light pencil or a wand reader.

Line Numbers: Numbers placed in front of a computer statement which tell the computer to store the statement. Line numbers are not used in some programming languages.

Line Printer: A high speed printer connected to a computer can print data at rates often exceeding several hundred lines per minute (LMP). This is achieved by printing a whole line at a time.

Looping: A programming technique used to repeat a single portion of a program. The repetition may continue indefinitely (an indefinite loop) or until some predetermined condition is satisfied (a conditional, or finite loop).

Low Resolution Graphics: The visual effects capabilities of the microcomputer which divides the screen into 40 vertical and 40 horizontal rows. The choice of different colors for low resolution graphics on the Apple II are 16.

Machine Language: The lowest level of programming. Machine language is the only language that can be directly understood by the computer. This is the only language the computer can understand without the assistance of an assembler, compiler or interpreter.

Magnetic Core: A data storage device based on the use of a highly magnetic, small, doughnut-shaped piece of iron capable of assuming two discrete states of magnetization. See core storage.

Magnetic Disk: (See Disk)

Magnetic Tape: The magentic tape used for secondary storage on a computer system. It is much like that used on a home tape recorder, although it often is of higher quality. Recording densities of 800, 1600, or 6250 characters per inch are common. Thus a large reel of tape can store many millions of characters of information. Standard audio cassette tapes can be used as a secondary storage medium with most microcomputers as well.

Mainframe: The main elements of a computer system, usually the CPU and main memory systems. Generally, however, mainframe is used to refer to a large centrally located computer with numerous terminals as opposed to a mini or microcomputer.

Megabyte: A million keystrokes; a million characters.

Memory: A circuit that stores information in specified locations (called addresses) where the computer can retrieve it as needed. Most computers have a primary memory with very fast access which is relatively small, and a secondary storage which can contain a large number of characters of information, but has slower access time.

Menu: A list of numbered descriptions of programs which are ready for execution by pressing one of the numbers.

Microcomputer: Hardware composed of a group of separate elements including read-only memory (ROM) and random-access memory, (RAM) microprocessor, interface logic for input/output (I/O), timing circuitry, and circuitry for transmitting signals from one element to another.

Microprocessor: A very small silicon chip imprinted with the circuitry for a complete CPU and main memory system, which can be used in a microcomputer. A single integrated circuit ( ) chip.

Microsecond: On-millionth of a second. Useful in discussing speeds of computer peripherals such as input-output devices and secondary storage. The access time for a disk might be 25 to 100 milliseconds.

Modem (Modular-Demodulator): Converts digit signals to analog signals which allow transmission of data on a telephone line.

Modulator: A device that lets a computer use an ordinary television set as a display screen. This term is used mainly with respect to personal computers since as such modulators are not generally used with larger machines. It is sometimes referred to as an RF modulator. RF stands for Radio Frequency, meaning television broadcasting.

Motherboard: The central communications bus line. The spinal cord of a microcomputer.

Nanosecond: One thousandth-millionth (that is, a billionth) of a second.

Optical Character Recognition: The machine reading of typewritten or handwritten characters. The typewritten or carefully hand-written materials are now commonly read by computers, but computer reading of general human handwriting is still a research problem.

Output: The results of computer operations on input.

Output Device: The hardware that receives processed input signals and puts them into a form understandable to computer user; e.g., a line printer.

Paddles: Hand held controllers used for games and graphics functions which work independent of the keyboard. Capable of drawing lines and moving the cursor about the screen in any direction by turning a dial.

Parallel: A type of interface in which all bits of data in a given byte are transferred simultaneously, using a separate data line for each bit.

Parameters: Values that are fixed in a program for a specific purpose. Such as a number of times a specific question may be missed.

Pascal: A highly structured language designed to teach programming as a systematic discipline and to do systems programming.

Peripherals: External devices connected to the main computer CPU and memory systems. Examples of peripheral devices are magnetic tape units, disk drives, printers, graphics tablets and other input/output devices.

PILOT: A high level language developed specifically for preparing computer-assisted instruction courses.

PL/I: A computer language designed for programming both scientific and commercial applications. One of the more modern compiler languages.

Primary Storage: The fast-access part of a computer's memory system. It operates at a speed comparable to the arithmetic and logic unit. It is generally much smaller in storage capacity than the secondary storage part of the memory system.

Program: A set of instructions which instruct the computer to do a certain task.

Programmable Read Only Memory: (See PROM)

PROM: Programmable Read Only Memory. This is a computer memory which does not forget what it knows, even when the power is shut off. Some kinds of PROM can be erased and reused; EPROMs, or Erasable PROMs. PROMs are a convenient way for the user to design his own operating system software and other tailor-made monitor routines.

RAM (Random Access Memory): The main memory or storage device. Information can be written into and read out of this memory and can be changed at any time by a new write operation. The contents are usually lost when the power is shut off.

Random Access: Access to data storage in which the position from which information is to be obtained is not dependent on the location of the previous information, as on magnetic drums, disks, or cores. The time required to access a piece of information is nearly constant (nearly independent of the location of the information). Also called direct access.

Random Access Memory: (See RAM)

Read Only Memory: (See ROM)

Real Time: A computer system operating immediately as data is input, with the CPU immediately replying to the user via output lines.

Record: A group of related pieces of computerized information. For example, a student's transcript might be one record, and the collection of all transcripts for a school might be one file.

Remarks: The commentary that is written into a computer program strictly for the benefit of a person to help them follow the program. In BASIC such "remarks" are prefaced by a "REM" in Mark and PILOT it is prefaced by an "R:". The computer ignores these statements during the execution of the program.

Response Time: The elapsed time between the completion of an input message at a terminal and the display of the first character of the response.

ROM: Read Only Memory. Non-erasable, permanently programmed memory usually used to store monitors and I/O drivers needed whenever the computer is used. Programs stored in ROM are called Firmware and cannot be modified by the user.

RS232: An industry-wide standard protocol for serial communication between computers and peripheral devices.

Run: A BASIC command which instructs the computer to execute the program presently on file in the computer.

Secondary Storage: A peripheral storage device that can store information in a form acceptable to the computer, such as on magnetic tape, disk, or drum. It is also called bulk or auxiliary storage, and its cost per character of storage is usually considerably less than for primary storage.

Sequential Access: A process which consists of reading or writing data serially, and by extension, a data-recording medium that must be read serially. Magnetic tape is a sequential access storage medium.

Serial I/O: A method of transmission in which bits are sent and received one by one.

Simulation: A computer program which models some system, typically using mathematical techniques.

Software: Generally used to describe computer programs, but also used to refer to everything that is not equipment (hardware).

Source Program: The original program that is written in assembly or high-level language and is translated into a machine-language object program for use in the computer by an assembler or compiler program (respectively).

Statements: The instruction which follows the line numbers that the computer reads and executes at the appropriate time. e.g., 100 PRINT "I'm pretty smart for my age."

String: A group of data elements (usually ASCII characters) stored in sequential memory locations and treated as one unit for I/O operations, text editing and other program manipulations.

Subroutine: A subprogram within a larger program.

System: An assembly of components united by some from of regulated interaction to form an organized whole. A computer is a system consisting of hardware and software.

Terminal: An input/output device linked directly to the computer by data lines. A device for communicating with a computer using a keyboard and an alphanumeric printer or cathode-ray tube (CRT) display.

Time-Sharing: A means by which one or more terminals can be connected to and work with one central computer system.

Translator: A computer program which translates from a high-level language such as BASIC into a lower-level language such as a machine language.

TTY: Abbreviation for a teletypewriter keyboard terminal. This is the most widely used of all general-purpose keyboard terminals.

Turn-Key: A computer system ready to perform all tasks the moment you turn it on. Business and accounting software is frequently supplied in ready-to-run form on such a system.

Users' Group: An association of people who all have an interest in a particular computer or group of computers. They usually meet to exchange information, share programs and accomplishments, and trade equipment.

Word (Memory or Computer): The smallest unit of information dealt with by a computer. Words can specify data or instructions.

Word Length: The number of bits contained in a computer or memory word. The size of word length determines the flex ility and accuracy of the

WHAT IS PROGRAMMING LANGUAGE?

In order to discuss programming languages, we should first define what a computer program is. Very simply, a computer program is a series of commands or numbers that tell the computer what to do. The computer can do nothing until given explicit directions in the form of a computer program. Based on which computer program is in use, the computer "knows", for example, whether to play Super Invaders or print out a letter. As mentioned previously, a program consists of a series of commands or numbers. The type of commands or numbers used to write the computer program is referred to as a language.

TYPES OF PROGRAMMING LANGUAGES

There are a variety of computer languages available. Some of the names of languages you may be familiar with include: BASIC, Pascal, PILOT, COBOL, FORTRAN, or LOGO. Computer languages can be as different from each other as human languages are, and as if it were not complicated enough, different brands of computers use different versions of the same language. For example, the BASIC that works with a TRS-80 microcomputer will not work with an Apple microcomputer. This is the reason why programs written for use on one microcomputer cannot be used with another micro without modification.

Languages are generally developed for specific programming purposes. Some of the most commonly used languages are briefly described below:

BASIC--Beginner's All purpose Symbolic Instruction Code.
BASIC is a high level conversational programmer's language that uses English words such as PRINT, GO TO, READ, LET, and common

mathematical procedures. BASIC is probably the most commonly used language for developing commercial courseware. It is the standard language in most microcomputer and time share systems.

PILOT--PILOT is a high level easy to learn programming language designed specifically for teachers to use in developing educational software. PILOT is available for most microcomputer and time share systems.

Pascal--Pascal is a highly structured language designed to teach programming as a systematic process and to do systems programming. Although often more difficult to learn than BASIC or PILOT, the highly structured nature of Pascal lends itself to program revision and modification. Although relatively new, Pascal is quickly gaining in popularity.

LOGO--LOGO is a language developed at MIT by Seymour Papert. It is designed specifically for children to use in developing programming skills. LOGO has just recently been commercially released and is available on selected microcomputers.

AUTHORING SYSTEMS

A method of writing a computer program other than using a computer language involves using what is called an authoring system. An authoring system is simply a computer program that has been written to facilitate the development of instructional software. Generally, the authoring system will prompt the teacher/author through the entire instructional sequence. A major disadvantage to the authoring systems currently available is that the teacher-developed instructional software often reflects the limitations of the authoring system more than the instructionsl style of the teacher.