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ABSTRACT

This paper focuses on gender, ethnic, and social class differences in attitudes toward computers, access to computers, and use of computers in educational settings. Background on equity concerns in the late 1980s is provided, and reasons why this is currently considered an important issue are discussed. Recent data on differences in access and type of use for children of different ethnic origins, social class backgrounds, and gender are presented. Research on the consequences of these inequities is also considered. The following intervention programs and strategies that educators can use to alleviate inequities in educational computer use are summarized: (1) awareness of equity issues; (2) equitable access and distribution of resources among schools, within schools, and within classrooms; (3) monitoring of the type of computer use of different groups; (4) selection of unbiased classroom materials; (5) use of minority and role model panels; (6) cooperative learning environments; and (7) use of the Logo programing language. (52 references) (MES)

Equity Issues in Educational Computer Use

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Abstract

This paper focuses on gender, ethnic, and social class differences in attitudes towards computers, access t computers, and use of computers in educational settings. Implications of these inequities are also be discussed. The first section provides a background to equity concerns in the USA in the late 1980's. Recent research on the inequities in access and type of educational computer use, and the consequences of these inequities is the focus of the second section. Finally, I describe some intervention programs and strategies that educators can use to alleviate inequities in educational computer use.

Equity Issues in Educational Computer Use

Microcomputers moved into USA schools at an unprecedented rate for a new technology. In 1975, the first microcomputer was developed. By 1981, the majority of secondary schools owned at least one microcomputer (Becker, 1983) and by 1985, more than 90% of all public schools owned at least one microcomputer (Office of Technology assessment, 1987). Estimates of the number of computers in use in schools by 1987 ranged from 1.1 million to 1.7 million (Office of Technology Assessment, 1987).

Along with the rapid increase of microcomputer use in schools came a concern for inequities in access and use of microcomputers. Quickly it became apparent that richer schools bought more equipment and more expensive equipment for instruction; Black students had lower access to computers than White students; and girls used computers in and out of schools less than boys (Lockheed, 1985).

Inequities in educational microcomputer use associated with family socioeconomic status (SES), race/ethnicity, and gender is the focus of this paper. There are important differences to understand when discussing these inequities. Racial origin in the USA is associated with family income. Blacks, Hispanics, and Native Americans are disproportionately poor. Much of the funding for schools comes from local taxes, so schools in poor areas have much less financial support. Because of housing

segregation (particularly serious for Blacks), many of these poor schools are also predominantly minority. This means than when considering inequities for children of different color and family background, we must compare different schools and so we ask questions such as: Do schools serving mostly rich children have more computers than schools serving mostly poor children? Do students in predominantly Black schools use computers in the same manner as students in predominantly White schools?

In contrast, few schools in the USA are segregated by gender, and gender of the student is obviously not associated with family income. Thus, when considering inequities between girls and boys we ask questions about differences within schools and classrooms such as: Are as many girls enrolled in advanced computer programming classes as boys? What percentage of before and after school computer users are girls?

The purpose of this paper is to summarize the research on inequities in computer access and use for students by family background, race and gender. First, I discuss why the issue is considered so important in the late 1980's. Second, I summarize recent research data on the inequities in computer use and the consequences of these inequities, and finally, I describe some intervention strategies that can be used by educators.

EDUCATIONAL EQUITY IN THE U.S.A. IN 1989.

In The Mismeasure of Man, a discussion of the racism associated with the history of IQ testing and labeling, Stephen Jay Gould stated

> We pass through life but once. Few tragedies can be more extensive that the stunting of life, few injustices deeper than the denial of opportunity to strive or even to hope, by a limit imposed from without, but falsely identified as lying within (1981, p. 28).

It can be argued that in a democracy there is a moral imperative that equity must be an integral part of any educational institution. Every child deserves an environment that best supports his/her learning and growth. Thus, it is the duty of every policy maker, administrator, teacher, and parent to ensure that schools have educational equity as a priority. However, in the USA this rarely occurs. Why?

The reasons are not simple, but the belief in the Horatio Alger myth is an important component. Alger wrote stories for school age boys during the late 1800's and the message in these stories was consistent. Anyone could make it in the "Land of the Free" with individual hard work, initiative, pluck, virtue and luck. In the stories luck always played a significant role but this has largely been forgotten in the popular version of this myth. Also forgotten is that all the heros in these stories were white boys.

This myth is associated with the widespread belief that those who make it are much more deserving than those who do not. Explanations for why some individuals are less deserving and do not make it typically fall into three categories of blaming the victim (the three "C's"): a deficit culture (e.g., "Native American culture is dysfunctional"), weak character (e.g., "He is lazy," or, "She drinks too much") or defective chromosomes (e.g., "Blacks are genetically inferior to Whites.") In this argument, the lower academic achievement on standardized tests of Blacks, Hispanics and Native Americans is predominantly their fault, and the lower incomes of women is their fault. Inequities in the structure of society are not considered important. In the 1980's an increasing number of women and minorities moved into the middle class, and even though these numbers are still small, they are used to support this myth. Some can make it, therefore something must be wrong with those individuals who do not.

These cultural beliefs, particularly prevalent in the 1980's have contributed to the rationale used to consider the importance of equity in education. Current discussions rarely focus on a moral imperative, because this is not considered a legitimate or persuasive argument. Rather, the focus is on economic and global competitiveness concerns. USA perceives that it is loosing its predominance in the world on economic and political issues. The 1983 report A Nation at Risk (U.S. Department of Education), a government sponsored examination of the quality of U.S. education, began,

> "Our Nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world" (p. 5).

An internationally competitive society in a post industrial age needs a well educated work force. This work force in the USA (as in New Zealand) increasingly is consisting of women and people of color. Currently, a majority of adult women are in paid employment. In 1982, 73% of the school age population was White, but by the year 2020 it is projected that only 54% school age population will be white. In 1982, only one in ten children were Hispanic, by the year 2020 one in four children will be Hispanic (Pallas, Natriello & McDill, 1989). Thus, if the USA is to maintain a competitive place in the world economy it must educate female and minority children as they are needed as future workers.

In major cities, these demographic changes are already evident. In 23 of the 25 largest school systems, white students are in the minority (Hodgkinson, 1985) and in 1988, California became the first state to have minorities constitute a majority of its public school students. Minority children have lower levels of achievement as measured by standardized tests (National Science Foundation, 1986) and in some large city systems it is estimated that more 40% of students drop out before graduating from high school (Wilson, 1987). Business leaders in a number of cities are reporting they cannot find enough entry level workers with the required minimum educational skills. Some of

the consternation arises from crass self interest: a colleague of mine at a recent meeting spoke of her concern that there will not be enough educated workers to support her in her old age. These societal and demographic trends have been well publicized and have lead to widespread concerns about equity in education.

In the last few years equity issues have become one of the "hottest" topics in educational circles: universities are creating urban educational research institutes; papers concerning "at risk" children flood conferences; books and monographs on inequity in education are increasing; experimental intervention programs are being implemented and evaluated; and businesses are forming partnerships with school districts to provide jobs, financial aid to talented students, mentors, and support. Many of these discussions and actions involve a concern for the use of technology as there is a common belief that computer competence is the fourth basic skill (U. S. Department of Education, 1983). It is widely assumed that not only must all future workers must be "computer literate" (Nobel, 1984) but also that technology can be used to help solve the educational problems "at risk" children face (Agency for Instructional Technology, 1987; Technology and the at-risk student, 1988). In the next section, I present data on inequities in current computer use in schools and consider the consequences of these inequities.

INEQUITIES IN EDUCATIONAL MICROCOMPUTER USE

Inequities in computer use can occur in a number of ways. First, I discuss the recent data on differences in access and type of use for children of different ethnic origins and social class backgrounds. Gender differences are also considered. Second, the some research on the consequences of these inequities are considered.

Access and Use of Computer

Differences in SES and Ethnic Origin. Recent surveys comparing schools with pupils of different social class backgrounds and different ethnic origins have shown consistent and predictable inequities. In 1985, the ratio of students/computer was nearly twice as favorable for schools containing high SES students than in schools containing low SES students (Office of Technology Assessment, 1987). Students in elementary and middle schools with majority Black enrollment, had approximately only half the computer access compared to students in elementary and middle schools with less than 5% Black enrollment (Becker & Sterling, 1987). Not only do high SES and White students have more access to computers in schools, but they also use computers differently. For low SES students, 56% of their use was for drill and practice and only 13% of the use was for computer programming. In contrast, for high SES students, 39% of the use was with drill and practice with 30% of the use

for programming (Office of Technology Assessment, 1987). This means that the low SES children, who are disproportionately Black and Hispanic, are gaining most of their experience with a computer when it is in control, asking questions, expecting a response, and informing the student when she or he is correct. In contrast, the high SES students, who are disproportionately White, are gaining considerable experience when they are in control giving the computer a series of instructions and observing the consequences of these instructions.

Disparities in school access and use among children of different backgrounds is reflected in at-home use. In 1985-6, 32% of White students owned computers compared to 22% Black students and 21% Hispanic students. Children of parents who had graduated from college (University) were three times as likely to own a computer than children of parents who had not completed high school (Martinez & Mead, 1988). Thus poor and minority children have less access to computers both at home and at school.

Gender Differences. There are wide variations in gender use of computers in schools, however average figures indicate that girls are under represented in every category of use at every level except for one, high school word processing! The largest under representation is in game playing with girls at middle schools only participating in 28% of this activity, and before-and-after-school use with boys at middle school dominating 78% of the use (Becker & Sterling, 1987). Other studies support these

findings. In-school differences in programming classes, even elective programming classes, seem to be diminishing, but out-of-school use is very inequitable (Lockheed, 1985). At home use reflects these differences. Families of male students are much more like to own a computer than families of female students (Martinez & Mead, 1988; Swadener & Jarrett, 1986). Also, boys are three times as likely to attend a summer computer camp than girls (Hess & Miura, 1985).

Consequences of Differential Use

Differential access and type of use may have consequences for students in several ways. First lower access may lead to lower computer skills. It is commonly believed that in the future computer skills will be necessary to be competitive for many jobs, and also necessary in order to participate effectively in society (Nobel, 1984). Information is too extensive and changes too rapidly for anyone to recall all the important facts in her or his field. Thus, we need people who know how to access, organize, and interpret relevant information (Sheingold, Hawkins & Kurland, 1984) Increasingly, these skills involve the use of microcomputers and electronic data bases.

Not surprisingly, students with more experience using computers are more competent in their knowledge about computers (Martinez & Mead, 1988) and in their use of computers (Kersteen, Linn, Clancy, & Hardyck, 1988; Martinez & Mead, 1988; Waugh, 1986). This experience may be gained at home or at school, and

one study reported that pupils who had computers at home believed that more of their learning about computers was done at home than at school (Martinez & Mead, 1988).

The second consequence differential access of computers may have is in attitudes towards computers. With the rate computer technology changes, attitudes towards this technology may be as important as skills with a specific machine. Individuals who are not anxious, but rather view computers positively and are confident about their ability to use computers, will be more likely to learn whatever new skills are required by future developments in hardware and software.

Many studies have found that girls have less favorable attitudes towards computers than boys (Chen, 1986; Collis, 1985; Levin & Gordon, 1989; Miura, 1986; Wilder, Mackie & Cooper, 1985). However, when the researchers explored the role of experience on attitudes they found that these gender differences can be explained by differences in amount of experience. That is, for boys and girls who have the same exposure to computers, their attitudes are the same (Chen, 1986; Levin & Gordon, 1989). Other studies on attitudes and experience have also found that more experience is associated with better attitudes (Loyd & Loyd, 1988) and less anxiety (Loyd & Gressard, 1984).

Gender related stereotypes about competence using computers are still prevalent. In a recent survey, 38% of the boys believed that boys were more competent in using computers, whereas only 4% of the girls believed boys were more competent

(Martinez & Mead, 1988).

The discussion of the consequences of the inequities of computer use and type of use up to this point has focused on computer competence and attitudes towards computers. Another consequence that may arise from differential access is in the use of the computer as an instructional tool. If using the computer as an instructional tool (e.g., in drills, tutorials, simulations, problem solving packages) is a particularly effective form of instruction, then "at-risk" children will be further disadvantaged by their lower access to this teaching technique.

Reviews of research have found modest achievement gains for pupils receiving computer aided instruction (CAI) compared to children receiving traditional teaching (e.g., Kulik, Kulik & Bangert-Drowns, 1985; Samson, Niemiec, Weinstein & Walberg, 1986; however see criticisms of this research by Clark, 1985). Research on the achievement gains for minority, low SES, low achieving or female children is inconsistent. Current findings suggest that CAI is particularly beneficial to low achieving pupils and to males (Bangert-Drowns, Kulik & Kulik, 1985; Niemiec & Walberg, 1985; Samson et al, 1986;) but more research is needed.

Hativa (1988), interested in the effectiveness of CAI for low and high achievers, observed in detail the strategies high and low achieving elementary students used to effectively work through a tutorial containing material not yet studied in class.

Low achievers more than high achievers were prone to make mistakes associated with hardware and software and were less able to adjust to the special environment of computer work and derive great benefits from it. Other research has indicated that many students need teacher intervention when students are using complex software (Stein & Linn, 1985; Sutton, 1987).

Much more research on the effectiveness of using computers as instructional tools with poor and minority students is needed. It has been found that in traditional classrooms low SES students need more active instruction, more feedback, more warmth, support and encouragement (Brophy, 1986). Do these same characteristics apply to computer aided classrooms? If yes, can they be incorporated effectively when using the computer as an instructional tool? Intervention strategies that have been used in the USA are discussed in the next section.

STRATEGIES FOR EQUITY IN COMPUTER USE

In this section I summarize a variety of strategies that can be used to alleviate inequities in school uses of computers. Many of these strategies were developed for use in intervention programs aimed as increasing the numbers of females and under represented minorities in math and science. Some strategies are specific to inequities problems related to microcomputer use.

Unfortunately, the research evidence on the effectiveness of many of these strategies is limited. In particular, we know

little about classroom instructional techniques that should be used with minority children. Our data base on techniques that are beneficial to females is stronger and it does seem that "girl-friendly" classrooms are classrooms that are friendly not only to girls but to many students (Eccles, MacIver & Lange, 1986). Therefore, until we know more, adopting classroom techniques devised to support girls it a good first step in any classroom. [The best source of practical information for teachers using computers is contained in the book, The Neuter Computer (Sanders & Stone, 1986)].

Awareness

Awareness of equity issues is a prerequisite for any solution at the national or local level. Policy makers at the national need data on hardware, software, and human resources in different school districts. Principals and teachers need to obtain information on equity and microcomputer use in their schools.

Access

Inequities in access and use cannot occur until technological resources are equitably distributed among schools. This means that policy makers must provide special funds for the necessary resources in under funded areas, and private foundations should be encouraged support such projects (McPhail,

1985). These resources do not include just hardware. Costs for software and staff training far outweigh hardware costs (Levin, 1986).

Not only must access be provided at a school level, but equal access needs to be provided within schools and within classrooms. There are many ways schools can unwittingly restrict access. Some high schools in the USA have policies that only students with 2 years of elective mathematics are allowed to enroll in programming classes. This tends to keep out females, and students who are not high achievers. Certainly, students who are high mathematics achievers perform better in programing classes, but so do students who have high verbal achievement test scores (Bitter & Lu, 1988; Webb, 1984). Introductory programming can be taught to students who have very little mathematical background.

We know that some assertive children (more typically boys) often push their way to computers and get more computer time both before and after school. This can lead to a "boys computer room" atmosphere. One strategy for overcoming this requires using sign up sheets for computer classroom use. No child gets a second turn until all children have had a first turn (Sanders & Stone, 1986).

If the computer lab or club has become an all-boys atmosphere the teacher may have to schedule time for an all-girls time or develop an all girls club. (This can be applied to any group that has taken over a lab - it could be it has become an all Pakeha domain and teachers need to encourage Maori students).

Teachers also need to be careful about giving too much attention to keen and eager students who may have at-home access. Some of the less eager students probably need extra help getting started.

Type of use

Principals and teachers need to ask questions about the type of computer use of different groups. Are more of the girls word processing and more of the boys programming? Are the problem solving and simulation packages only being used for high achieving white students? Is there an assumption that the primary use of the computer for low achieving and minority students should be for extra drill on basic facts? As educators, we typically assume that unless students have the basics they cannot do higher level thinking and problem solving. This means low achieving children always focus on low level skills and do not experience the variety of instructional software packages for problem solving. When two students are sharing a computer, it is important that one child does not become the "thinkist" and the other the "typist" (Sheingold, Hawkins, & Char, 1986). Teachers can keep records to monitor, their students' use of type software and change their strategies if needed.

Classroom Materials

Many textbooks and classroom materials focus on activities that are more appropriate for males and for Whites. For example, a popular Logo text book by Harvey (1985) uses many male-oriented programs such as the development of arcade games and of a poker player. Stereotyping is so pervasive in society that it is easy for teachers and researchers to make mistakes. For example, a recent study by Guntermann and Tover (1987), investigated gender differences in Logo mastery used as their learning task the drawing of a truck. If possible, biased materials should not be used. If only biased materials are around, teachers need to supplement then with their own ideas and activities. It should not be assumed that all students are interested in drawing cars (or houses, or footballs) on a computer screen. Where feasible, students should be given a choice in their assignments so they can select activities that are meaningful to them.

Role Model Panels and Career Awareness

The current society stereotype is that White males are the only ones who know about computers. The use of minority and role model panels in classroom can be used to alleviate this stereotype (Tobin & Fox, 1980). These individuals can come from any field that uses computer technology as part of their job including computer technicians, programmers, administrative assistants, graphic artists, etc. Field trips to a nearby computer center, university, or business can be arranged.

Cooperative Learning

Recent research has shown that cooperative learning environments help all students, but they seem particularly beneficial for girls and minorities (Johnson, Johnson & Stanne, 1985; Johnson, Johnson, Tiffany & Zaidman, 1984; Peterson & Fennema, 1985). Cooperative learning environments can take a variety of forms. They may be informal, with children sharing a computer, or helping each other on an assignment. They may also involve formal arrangements where children are assigned to a specific group for a period of time. In formal arrangements it has been found that the cooperative arrangements need individual accountability (the group's success must depend on the individual learning of all members), group rewards, and group interaction (Slavin, 1983). Some cooperative learning advocates suggest that the groups should compete against each other in a team games approach (Slavin, 1987); others claim that better affective environments are gained when the teams are not pitted against each other (Johnson et al, 1984).

Choice of Programming Language

It can be argued that Logo is a better choice of first programming language than BASIC because it is more likely to appeal to a wide variety of students (Sutton & Burrowes, 1988). It appears that girls prefer to work with graphics and music when using computers (Sanders & Stone, 1986) and most versions of Logo lend themselves to the easy production of graphics design and

simple music. It also appears that many girls prefer to work with computer tools than just with computer programming (Lockheed, 1985). A version of Logo, LogoWriter, contains a word processor that encourages student to write and then use new-found programming skills to enhance their writing with graphics, animation and sound.

Conclusion

Equity in school computer use must involve not only equal access but also consideration of the learning needs of poor, minority and female students. Poor children, who are disproportionately minority, "are unlikely to have other resources apart from the school system for having their learning needs met - there is no other option, no 'redundancy in the system'" (Malcom, 1988, p. 217). This means equity concerns in educational computing are not something to worry about after enough hardware and software has been bought, and policies have been implemented. Equity must be a priority, a part of every policy decision and every classroom action.

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