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ABSTRACT

Research on microcomputers in education suggests that this new technology may be widening the gap between rich and poor schools and talented and underachieving students. Public schools in poor districts and small parochial schools are the least likely to own computers. One survey indicates that while 66 percent of affluent school districts have computers, only 41 percent of the least wealthy districts have them. Even among schools owning microcomputers, there is the question of how these computers are used in instruction. Wealthier schools tend to conduct classes in computer programming, while less affluent schools offer computer assisted instruction (CAI) such as drill and practice. Little research has been conducted on the success of CAI for disadvantaged students. The studies completed indicate that CAI has a positive effect on disadvantaged elementary and secondary students' computation skills, and on elementary students' language arts skills. On the less positive side, CAI shows mixed results in teaching vocabulary skills and reading to this student population. Schools serving disadvantaged populations must ask themselves whether these students are being served equitably by their exposure to computers, and when they are using computers, whether the curriculum is best suited to their needs. (LP)

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Microcomputers: Equity and Quality in Education for Urban Disadvantaged Students

Like educational technology preceding it, microcomputers have raised expectations of enhancing both equity and quality in education. In the initial years of their development for education during the mid-1960's, talking typewriters and other computers were used specifically in compensatory education contexts, often with dramatic results for poor, minority, elementary school students (Responsive Environment Corporation 1968; Vinsonhaler 1972).

Between 1965 and 1980, computer-assisted instruction increased twentyfold (Powers 1981), and the past several years have witnessed even more rapid growth. According to the Center for the Social Organization of Schools survey (CSOS 1983), over half of all schools in the United States had at least one computer for instructional purposes by January, 1983. However, issues of both equity and quality are currently unresolved. Research on microcomputers in education, a field which has mushroomed nearly apace with their growing popularity in the schools, suggests that this new technology may be widening the gap between rich and poor schools and talented and underachieving students, and that microcomputers as an educational tool—no more or less than books—is merely a technology with its benefits and limitations on which good and bad curriculum can be written, for advantaged as well as disadvantaged students.

Microcomputers and Equity

A number of authors have recently expressed concern with the possibility that microcomputers in education may increase the disparity between the haves and the have-nots; between rich and poor, white and minority, and male and female students (Anderson et al. 1983; Litman 1973; Nathan 1983; Scheingold et al. 1981). Several studies show significant differences among different types of schools in the purchase of computers.

According to the Johns Hopkins survey (CSOS 1983), the least likely owners of microcomputers are public schools in poorer districts and small parochial schools. Whereas 66 percent of the public schools in more affluent districts have them, only 41 percent of the schools in the least wealthy districts have any. A 1983 survey by Quality Education Data (quoted in Anderson et al. 1983) reports that the 12,000 wealthiest schools are 4 times as likely to have microcomputers as are the 12,000 poorest schools.

A 1982 report confirms these data on inequity: According to Hood (1982), there is a higher percentage of schools with microcomputers where schools spend more for instrucitonal materials, and "Schools with higher proportions of poverty level families are less likely (by more than half) to use microcomputers than are the wealthiest schools" (Hood 1982, p.9). Moreover, a National Institute of Education report (Goor et al. 1982) points out that, though large (generally urban) school districts purchase more computers than smaller districts, in small districts the estimated ratio of students to computer is 320-1, compared with a student-computer ratio of 980-1 in the large districts.

The Johns Hopkins survey (CSOS 1983) also found that schools already owning microcomputers were more likely to purchase additional ones than schools without any were to make an initial purchase. As Litman (1973, p.2) notes, this finding may actually 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 . . . . In fact, the wealthier schools are increasing their advantage over the poorer ones."

Once an elementary or secondary school has purchased a computer, important questions still remain about which students will be its greatest beneficiaries and for what kinds of instruction the technology will be used. A survey of computer usage by district (Goor et al. 1982), indicates that instruction in "computer literacy" was the most common educational use, reported by 85 percent of the districts with computers. Moreover, 64 percent of the districts reported using their computers for high achievers, in comparison with only 45 percent who used them for compensatory education students. According to Watt (1982, p.59),

> 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.

A National Assessment of Educational Progress survey (Anderson et al. 1983) confirms Watt's analysis with the finding that the number of students enrolling in computer programming courses is much lower in schools that qualify for Title I assistance than those that don't. According to their survey, only 7 percent of all 17-year-old students in Title I schools had taken programming in 1982, while 14 percent of all 17-year-old students in other schools had taken such courses; moreover, a comparison between 1978 and 1982 survey results shows the gap between computer programming enrollment in schools in wealthier and poorer communities to be widening.

In a descriptive analysis of the use of microcomputers in one large urban, one small urban, and one suburban school district, Scheingold et al. (1981) discovered varying but always ability-stratified usage patterns. One pattern was the provision of programming courses to students "good in math" and computer-assisted instruction to "disabled learners," while the vast middle range of students had no contact at all with computers. The authors warn against "contributing to a future in which levels of achievement determine what students are permitted to do with computers . . . . The educational assumptions behind such a division of applications, as well as the likely educational outcomes, need careful examination" (Scheingold et al. 1981, p.102).

Problems in Evaluating the Quality of Computer-Assisted Instruction for Socially and Academically Disadvantaged Learners

Research on the success of computer-assisted instruction for disadvantaged students has been relatively scarce and problematic. A number of methodological difficulties stem from the definition of the population, on the one side, and the social context of computer usage, on the other.

First, is the problem common to most research on disadvantaged populations: one is rarely certain whether the group is being defined by test scores, grade-level achievement, poverty, or simply some indicators of race or ethnicity. Equally fundamental is the lack of information about specific learning strengths and weaknesses of students within this poorly-defined group, and whether these students are individually matched with the computer programs offered them.

Next are research issues connected with the computer itself. Most studies do not describe the program used. Rather, the evaluations suggest that it is the technology delivering the curriculum, not the curriculum itself, that is affecting student achievement.

Questions also arise concerning the classroom context in which the computer is used. Is time on the computer used in coordination with other teaching? What are the student-computer and the student-teacher ratios? What percentage of time is spent in "traditional" as opposed to computer-assisted learning? A number of studies compare control groups of students who learned for, say, an hour through a traditional curriculum with those who supplemented this hour with ten additional minutes of daily computer-assisted instruction (CAI). Would ten more minutes a day of any instruction be of equal use? As Becker (1983) points out, although most well-financed research has involved heavily-monitored and well-managed CAI with a sufficient number of computers for participating students, little research exists to determine whether the more typical drill-and-practice materials used under usual school conditions of one or two computers for the entire student population allows for any appreciable gain.

Finally, research on computers tends to study the relatively narrow cognitive skills the machines enhance. There is no research on disadvantaged populations that focuses on the effects of regular computer practice on the growth of other kinds of cognitive skills; nor is there research that analyzes the effect of reduced social interaction on learning.

Research Findings on Computer Effectiveness for Urban Disadvantaged Students

Findings about the results of using computers for drill and practice and low level tutorial work with disadvantaged students are rather mixed, with a slight edge on the positive side.

There are a number of studies showing positive results when using CAI with elementary school students. Jameson et al. (1971) used 10 minutes of daily CAI instruction in math and reading with first graders; they found significant differences in favor of the CAI group. Nabors (1974) compared 50 fifth and sixth graders using CAI for reading comprehension and general problem-solving to a similar group receiving traditional instruction; statistical differences at the 5 percent level favored the CAI students. Wells et al. (1974) reported one-third higher achievement gains for fifth and sixth graders using CAI than a comparable group not using computerized instruction. In a study of CAI used for reading, language arts, and math drill in 21 elementary schools in Chicago, Litman (1973) reported gains of 1 month for each month in the program, compared with the national average of 5.6 months for 8 months of instruction among compensatory education students. A study jointly sponsored by the Educational Testing Service and the Los Angeles public schools (Ragosta et al. 1982) focused on CAI for math, reading, and language arts instruction in the elementary school years. The authors reported positive, though varying, and "ungeneralizable" results, including large gains in computational skills, with 10-20 minutes of mathematics CAI daily, and increased computational gains in the second and third years; and smaller gains in language arts and reading, but no gains in the second and third years. The authors also note that the benefits from mathematics CAI were about equivalent to that of mathematics tutoring.

Among the studies focusing on the middle and secondary school years, two also show positive results. In a several-year study by Hirschbuhl et al. (1980), CAI in a remedial reading program for seventh and eight grade students gave the CAI group 2 months growth for every month in the program, compared with only 1.4 months growth for student controls. Modisett (1980) compared the remedial effects of CAI with paper-and-pencil workbooks on high school students and found that the former led to better computational skills.

On the less positive side, a large study of nearly 3000 students in grades 3-8 (Lysiak et al. 1976) found very mixed benefits in vocabulary and reading, depending both on the age of the students and test used. Levin and Woo (1980) used 10 minutes of daily CAI instruction to supplement the regular curriculum at different elementary levels and found little proof of educational improvement.

As for studies showing more mixed results with secondary school students, Maser et al. (1977) conducted a three-year study using CAI drills ten minutes daily to teach basic skills; their findings indicate that students in the lower percentile made the greatest gains, while results were less impressive with higher achievers. The authors hypothesize that the materials used may not have allowed for enough growth by more proficient students.

Computer-assisted instruction has also been used with poor and minority low-achieving students in colleges and out-of-school learning situations, where its benefits appear to be the most problematic. A three-year study by Buckley and Rauch (1979) of CAI in Adult Learning Centers found students making significant cognitive and affective gains compared with controls; staff considered CAI students more independent and o[illegible] to new avenues of instruction. Kester (1982) studied CAI in remedial programs for college students; his analysis indicates greater improvement for the students who used CAI than those who didn't, but significantly higher attrition rates for CAI students than for controls. Argento et al. (1980) compared basic skills learning of CAI students with controls in nine Job Corps Centers and found little difference between the two groups. A more recent study of CAI in Job Corps Centers by Geller and Shugoll (1983) showed mixed but promising findings, with significantly greater reading, but not math, gains for the CAI group than for the controls. In all of these college and out-of-school programs, however, the results are confounded by high but uneven attrition, which may be exacerbated by computerized instruction.

Although computers appear far more frequently in secondary schools (Goor et al. 1980; CSOS 1983), there is some indication from this small body of research as well as from the research on general student populations that CAI is most useful in the elementary school years (Ragosta et al. 1982). The literature on general populations also supports the finding reported here that gains with CAI among college students are least impressive (Ragosta et al. 1982).

The questions schools serving disadvantaged populations must ask themselves are clear: Are these groups of students being served equitably in their exposure to computers? And, when they are learning to use computers or are receiving computer-assisted instruction, is the curriculum best suited to their needs?

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