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Abstract

The purpose of this study was to determine the extent of technology usage in public schools having high minority student enrollment and in public schools having low minority student enrollment. Specifically, our interest was in determining the extent to which technology usage differed by region of the country for minority enrollment. Three statistical differences were reported for percent minority and region in computer use to read, write, and spell, to learn math, and for science concepts. Computer use to read, write, and spell had the highest frequency among schools having 50% or more minority student enrollment, but less than 75% minority students in the Northeast, whereas the West and the Midwest followed in computer use frequency. The lowest frequency of computer use was found among schools having 50% or more, but less than 75% minority students in the South. Computer use to learn math had the highest frequency among schools in the West whereas the Midwest and the Northeast followed in computer use frequency. The lowest frequency of computer use was found among schools having 50% or more, but less than 75% minority students in the South. Computer use for science concepts had the highest frequency among schools in the West and Midwest, regardless of percent minority population. The lowest frequency of computer use was found among schools having 75% or more minority students in the Northeast and in schools having 50% or more, but less than 75% minority students in the South. Implications of these findings are discussed.

Instructional use of technology in the past decade has grown at a rapid rate in American public schools (Faltis & DeVillar, 1990). Computers seem to promise a technological solution; they are believed to solve long-term, expensive, and difficult problems in a relatively cheap and clean manner (Kerr, 1991). Traditionally, however, technology-driven reforms have not been welcome in education. The education system tends to accept technology-driven reforms as a quick fix and then after a period of time returns to the status quo (Cuban, 1986). Cuban (1986) pointed out that in the early phases of the introduction of computer technology, the educational system viewed it in the same manner as the introduction of radio and film.

According to Neuman (1991), many students are hampered by inequitable access to computers, and a widespread pattern exists of inequitable distribution and use of computers within public schools. When minority children have access to computers, they are usually engaged in drill-and-practice activities (Faltis & DeVillar, 1990) rather than higher order activities. Minority children tend to do what the computer tells them to do as in computer-assisted instruction, drill and practice; whereas, White middle-class children tell the computer what to do by learning to program computers (Harrell, 1998). Cummins and Sayers (1990) have argued that technology should not be used to maintain low-level tasks but to enhance critical learning and to oppose top-down social control orientation of minority students.

According to the U.S. Census Bureau, there are over 28 million minority children in the United States (U.S. Census Bureau, 2001). The majority of these minority children attend public schools that have a responsibility to teach and to educate all students. Because young children develop their academic foundations in preschool and these skills help promote future academic success (Schwartz, 1996), preschool minority children should have the same opportunity to use technology as preschool majority children. The frequency of technology use public school classrooms having a majority of minority children and schools with a low minority enrollment needs to be monitored to achieve equitable use of technology time.

Equity Access to Technology

Instructional use of technology in the 1980s and 1990's has grown at a rapid rate in American public schools (Faltis & DeVillar, 1990). Faltis and DeVillar (1990) stated that technology may be used to help address the needs of language and cultural minority children. But, caution needs to be taken when addressing these needs where the educational system is upgraded to meet the demands and needs of an increasing global economy (Cummins & Sayers, 1990). The needs of minority children need to be taken into account when developing and implementing these technology programs so as not to make minority children passive learners (Cummins & Sayers, 1990). Technology available to schools should not be used for trivial purposes but to develop critical thinking and higher order thinking skills (Cummins & Sayers, 1990). Technology innovations have been introduced into the classroom, examples include motion picture, radio, and television; however, the implementation of these technologies has not been very successful (Tyack & Cuban, 1995). Failures of these technologies were due to amount of time to set up and appropriateness in the curriculum (Tyack & Cuban, 1995).

Attention should be focused on the appropriate implementation of technology and its effectiveness on learning (Woodward & Cuban, 2001). Equity denotes equality of educational opportunities for all students regardless of race or ethnic background (Cohen, 2001). Changes at the classroom level need to take effect so that minority children can actively contribute their intellectual abilities, help maintain a high level of intellectual challenge in the curriculum, and provide the extra support that struggling students require- these elements will make a classroom more equitable (Cohen, 2001).

Digital Divide

The "Digital Divide" has been defined as the gap between the populations who have access to new technologies and those populations who do not have such access (Anthony, 2000; Tumposky, 2001, p.119). These populations not having access to current technologies include differences based on race, gender, geography, economic status, and physical ability (Brown, Higgins, & Hartley, 2001; Fueyo, 1997; Harrell, 1998; Harris, 2000; Tumposky, 2001; Woodward & Cuban, 2001).

In the 1980s when a "technology revolution" was taking place, access to technology was strongly associated with income (Sutton, 1991; Tumposky, 2001, p.119). Sutton (1991) stated that the availability of computers was limited to affluent people, which symbolized education and high social class. Computers in school were not widely used for instruction and Internet connections were almost nonexistent (Tumposky, 2001). Martinez (1994) using the National Assessment of Education Progress (NAEP) database found that student proficiency among a sample of 24,000 students was related to computer usage outside of the school setting; students having access to computers at home and at school were the most proficient users. In the 1990s, the price of computers decreased and schools were able to acquire more computers to be used in the classroom (Tumposky, 2001). A survey, focusing on income and price of computers, conducted by Milone and Salpeter (1996), found that 52% of those persons planning to buy a computer during the year had a household income of $40,000 or less.

The increased purchasing of technology and wiring for schools and households was thought to create a transformation of schooling and to bring more equity of access to knowledge for students of disadvantaged groups (Papert, 1997; Ravitch, 1993). Unfortunately, the results have not been positive; and, in fact, the opposite effect has been occurring (Hoffman & Novak, 1998). Recent data released by National Telecommunications and Information Administration (2000) were that people with disabilities were half as likely to have access to the Internet than those persons without a disability: 21.6% to 42.1%. Those people with disabilities and those persons having problems with impaired vision and manual dexterity have lower rates of Internet access and were less likely to use a computer than persons with a hearing disability.

Internet access data among ethnic groups were that Asian Americans and Pacific Islanders had the highest level of home Internet access at 56.8% (National Telecommunications and Information Administration, 2000) compared to Hispanics and Blacks at rates of 23.6% and 23.5% respectively. The national average for Blacks and Hispanics against the national rate of Internet access increased by an average of 3.5%: 23.5 for Blacks, 23.6% for Hispanics, as compared to the national average 41.5%; the gap of 3% for Blacks and 4% for Hispanics occurred from 1998 to 2000 (National Telecommunications and Information Administration, 2000).

Statistics obtained from the National Center for Education Statistics (2000) were that 95% of all public schools have connections to the Internet. In the classroom 63% of all classroom are connected to the Internet (NCES, 2000). In schools with a high concentration of poverty, with 71% or more of the student population eligible for free or reduced-price lunches, the ratio is 39% of instructional rooms connected to the Internet (NCES, 2000). Schools with a high concentration of poverty also had the highest number of students per computer with Internet access than did schools with the lowest concentration of poverty, 16 students to one computer with Internet access compared to 7 students per computer with Internet access (NCES, 2000).

Integrating Technology in the Classroom

Brown, Higgins, and Hartley (2001) have identified three issues that educators may use to bridge and to integrate technology into their classroom. These issues are (1) increasing access to technology (2) appropriate instruction and use of technology and (3) barriers to institutional technology (Brown et al., 2001).

Students from diverse ethnic backgrounds are restricted to access to computers during school hours and do not have access to computers in their homes (Becker & Sterling, 1987;

NCES, 2000). McKensie (1998) has suggested creating mini-labs throughout the school and have temporary computers stay in the classroom for extended periods of time. Lovitt, Perry and Hughes (1996) have suggested that partnerships could be created with universities to establish apartment schools in neighborhoods where Internet access is limited. Students could also be exposed to multimedia software, which would connect school-based learning to real world situations (Kozma & Croninger, 1992). Brown et al. (2001) suggested that teachers use after school hours in a creative manner such as offering evening and weekend technology courses to the community and allowing educators time to learn how to integrate technology into their instruction.

Technology integration, according to Collins (1991), should attend to the similarities and differences in the needs of students from diverse linguistic and cultural backgrounds. This instruction requires teachers to incorporate technology and to be flexible in the use of technology in their everyday instruction (Cummins & Sayers, 1990). This instruction requires students to be more active in their learning, encouraging independent and self-motivating learning, and relying less on whole-group instruction (Cummins & Sayers, 1990).

Classroom Use of Technology

Computer technology has been offered as the primary medium for translating learning theory into instructional practice (Pepi & Scheurman, 1996). As computer technology is accepted in the classroom, it goes through three different stages (Naisbitt, 1982). The first stage is the introduction of new technologies. These technologies follow the path of least resistance into a ready market. Second stage is the improvement or replacement of previous technologies with the new technology. The third stage is the discovery of new functions for the use of technology. This new discovery allows users to put technology into practice or test theory.

Computers in the classroom are being used to help determine the needs and to design appropriate solutions to education (Kyle & Dorricott, 1994). Teachers will be able to assess future demands of their students and the community. Teachers will be able to consider what is known about the learning process and will use available tools and techniques (Kyle & Dorricott, 1994). Educators will be able to integrate technology as a component of learning (Banathy, 1991). Integration of technology will allow students to learn and to develop at their appropriate rates. This rate will allow individualized instruction, which will raise the self-esteem of a student because learning will take place in a non-threating environment. This learning will help create a student who is proficient in accessing, evaluating, and communicating information.

Higher order thinking skills will be developed by integrating technology in the classroom (Shneiderman, Borkowski, Alavi, & Norman, 1998). This technology can foster an increase in the quality of students' thinking and writing and will allow students to solve complex problems. Higher order thinking skills cannot be taught and cannot be transferred; students develop these skills by themselves with appropriate guidance (Kyle & Dorricott, 1994). Students learn to struggle with their questions and search out their own answers.

Technology may also be used as a tool to express artistic ability and meaningful work (Banathy, 1991). Video production, digital photography, and computer-based animation have great appeal to encourage artistic expression among a diverse group of students. These tools may provide opportunities to those students constrained in a traditional curriculum. Technology will allow students to increase their problem-solving skills and to communicate their ideas. Creating these artistic expressions will add value to a student's education. The computer along with its related technologies may be used as a way to publish student work to the general public and to provide a widespread audience. Students' video products may be shown on local cable stations and may produce high levels of motivation and accomplishment (Kyle & Dorricott, 1994). Technology may be used as an equalizer for students who have no access to these tools, allowing students to view what is outside their environment. Thus, when teachers allow students to interact with technologies in meaningful ways for significant periods of time, teachers may be encouraged to try new things.

Student Use of Technology

Technology is a resource that is available for students to use (Fetterman, 1998; Kaufman, 1998; Kearsley, 1998). There are various search engines, which may be used to access information. Educational sites have vast resources, i.e., PBS, Smithsonian, National Geographic, and major universities have specific web pages, which can be downloaded and used as reference material (Kaufman, 1998). To use computer technology, teachers need to be properly trained and to have good leadership skills at all levels (Kearsley, 1998; Noble, 1998). Educators need to be proficient in the use of computer technology and not be afraid to use it. This knowledge of computer technology requires that teachers learn to work together as a team with the benefit of this teamwork being student learning (Hoerr, 1996; Timperley & Robinson, 1998). Computer technology is not meant to replace the teacher but can be utilized as resource (tool) to enhance learning (Kaufman, 1998; Shneiderman et al., 1998).

Student learning can be enhanced by the capabilities of technology. Computer technology can be used to help students manage data by sorting, storing, and analyzing data (Windschitl, 1998). Computer technology can provide students with access to the world outside of their domain. Thousands of computers all over the world are connected and serve as sites with their own web pages. This information can be a window for students to learn (Park & Hannafin, 1998; Sarason, 1998); a window that due to economic circumstances students have to access to these educational and cultural treasures. Web pages can expose students to other cultures, which may result in a better understanding of people who are different. Technology can provide students with up-to-date information on any part of the world (Sarason, 1998; Windschitl, 1998).

The use of computers in multicultural settings has a recent history. Moll and Díaz (1987) demonstrated that in a computer-mediated context where students were free to speak English or Spanish, language facility with both languages improved. In another study, Bellman and Arias (1990) used telecommunications to set up a cross-border project involving college students. Other research includes using computers as a means of communicating between students in U.S. schools with students in South America (Scott et al., 1992).

Barriers to Technology Use

Access to computer hardware, software, and the Internet is crucial to implementing technology, as is effective training in both the use of the technology and in how to use it to meet educational goals and standards (Cuban, 2001). Additional barriers are the availability of hardware, software, and the Internet; lack of release time for teachers to learn to use the technology; poor or non-existent staff development; lack of time in the teaching schedule for students to use the computers; lack of support from administrators; and lack of technical support on campuses (Cuban, 2001).

According to a recent NCES (2000) report, one of the leading barriers to technology integration is the lack of computers. Studies conducted by the NCES (2000) reported that 90% of instructional rooms have at least one computer whereas 23% of the teachers surveyed stated that they had no Internet access in their classrooms. According to Becker (2000), a strong relationship is present between how students use computers and how many computers are available for their use. Becker (2000) stated that teachers who have clusters of computers use them more for instruction than to enhance learning by giving students access to the Internet. For teachers who only have limited access to a computer settings, i.e., computer labs, students and teachers may get to use the computers only once or twice per month (Becker, 2000).

Purpose of the Study

The purpose of this study is to determine the extent of technology usage in public schools having high minority student enrollment and in public schools having low minority student enrollment as a function of region of the country. If differences exist in the extent of technology usage as a function of minority enrollment, then programs should be developed to insure equitable allocation of resources for technology and to monitor how these technologies are used by minority kindergarten students enrolled in public schools.

Research Question

Is there a statistically significant difference in student computer use (a) to learn reading, writing, or spelling; (b) to learn math; (c) to learn social studies concepts; (d) to learn science concepts; (e) to learn keyboarding skills; (f) to create art; (g) to compose and/or perform music; (h) for enjoyment; and, (i) to access information in high minority student enrollment public schools and low minority student enrollment public schools as a function of region of the country?

Methods and Procedures

Participants

The Early Childhood Longitudinal Study, in sampling 22,000 kindergarten students, gathered data through questionnaires in which families, teachers, and schools of kindergarten children were targeted. In the questionnaires, teachers were asked to provide information about their background, experience, teaching practices, and to provide information on their classroom settings. The sample size for this particular study was determined by the number of minority kindergarten students identified through the questionnaires. Estimates from U.S. Census 2000 have identified over 28 million minority children under the age of 18 years old. The weighted sample included 318 schools that had a minority population of 25% or less, 63 schools that had a minority population of 50% or but less than 75%, and 96 schools that had a minority population of 75% or more.

Instruments

Questionnaires developed for the Early Childhood Longitudinal Study were used for this study (Early Childhood Longitudinal Study, 1999). Questionnaires were composed of five different parts. The first survey provides information about class size and the children in the kindergarten classrooms. The second survey emphasizes classroom organization, kindergarten readiness, school climate, and teacher information. The third survey provides information on the academic rating of students. The fourth questionnaire was geared toward administrators.

Part C of the questionnaire asked teachers to report information on the sampled students. Teachers responded to a set of 20 questions about a student's academic performance. An academic rating scale was used to gather data on a sampled student's skills in language and literacy, general knowledge, and mathematical thinking. This questionnaire also collected data on a student's social skills (Early Childhood Longitudinal Study, 1999). Emphasis in this study was on the instructional activities of the teacher using the Spring Kindergarten Teacher Questionnaire Part A. Item 33 measured the frequency of use of computers in the classroom and was used in the statistical analysis.

Procedure

Data collection involved the use of the National Center for Educational Statistics Early Childhood Longitudinal Study (Early Childhood Longitudinal Study, 1999). These researchers had access to the national database by obtaining the public-use data files whereas the names of schools, teachers, and students were reported in an anonymous manner. Using the ECLS-K base-year database, a tag list of items was generated, which included: teacher identification number, teacher full weight sample, school type, public or private school, total enrollment, percent of Hispanics in class, number of LEP students in class, frequency use of math activities, frequency use of language and literacy activities, and computer use for a variety of activities. Once the variables were tagged, the list was saved and if further addition or deletions of variables are necessary, the saved tagged list was then used. Once the tagged list was saved, the variables were saved as a Statistical Package for the Social Science (SPSS Windows 11) syntax file. This SPSS syntax file was then opened using SPPS and the entire script was highlighted to extract the appropriate variables in SPSS.

Once the variables were extracted, a relative weight with the design effect variable was created in the SPSS database. Weights are used to compensate for differential probabilities of selection at each sampling stage. Weights are also used to adjust the effects of nonresponse from teachers (Early Childhood Longitudinal Study, 1999). The use of weights is essential to produce estimates that are representative of the population of kindergarten teachers (Early Childhood Longitudinal Study, 1999). The relative weight was calculated by inserting the variable teacher full weight and dividing by the mean weight of the Spring-kindergarten questionnaire which is 58.64. The design effect was calculated by inserting the variable relative weight. The average design effect of the longitudinal study was obtained from the Userguide found on the ECLS-K Base-Year Public-Use CD. The average design effect of 2.5 was then divided by the teacher relative weight variable. The design effect is used to avoid clustering. In SPSS, the design effect is used to correct standard errors based on a simple random sample (Early Childhood

Longitudinal Study, 1999). The weight icon on SPSS was then turned on and analyses conducted.

Results

To determine whether a statistically significant difference was present between high minority student enrollment public schools and low minority student enrollment schools as a function of region, a multivariate analysis of variance (MANOVA) was conducted, with percent minority (i.e., 25% or less, 50% but less than 74%, and 75& or more) and region (Northeast, Midwest, South, and West) serving as the independent variables and use computer to learn reading, writing, or spelling, use computer to learn math, use computer to learn social studies concepts, use computer to learn science concepts, use computer to learn keyboarding skills, use computer to create art, use computer to compose and/or to perform music, use computer for enjoyment (e.g., games), and use computer to access information (e.g., to connect to the Internet or local network) serving as the nine dependent variables. A statistically significant overall effect was present for percent of minority student enrollment and region, Roy's Largest Root F (9, 445) = 3.59, $p < .001$, indicating that computer use was different among the regions and percent minority of students enrolled at the school. The effect size for this overall difference was .27, moderate (Cohen, 1988). Follow-up univariate Fs revealed three statistically significant differences in computers to read, write, and spell, F (6, 448) = 2.26, $p < .05$, in computers to learn math, F (6, 448) = 2.39, $p < .05$, and in computers for science concepts, F (6, 448) = 2.31, $p < .05$. The effect sizes were small (.17), small (.18), and small (.18), respectively (Cohen, 1988).

Estimated marginal means revealed that schools in the Northeast with a minority population of 50% or more but less than 75% had a higher frequency of computer use to read, write, and spell (M = 4.9, computer use three or four times a week) than schools with more than 75% minority population (M = 3.2, computer use two or three times a month) and less than 25% minority population (M = 3.1, computer use two or three times a month). Schools with 75% or more minority students use computers to read, write, and spell more than schools with less than 25% minority students.

In the Midwest, schools with 75% or more minority students (M = 3.8, computer use once or twice a week) had a higher computer use to read, write, and spell than school with 50% but less than 75% (M = 3.6, computer use once or twice a week) and schools with less than 25% minority students (M = 3.6, computer use once or twice a week).

In the South, schools with 75% or more minority students (M = 4.5, computer use three or four times a week) had a higher frequency use of computers to read, write, or spell than schools with less than 25% minority students (M = 3.9, computer use once or twice a week) and schools with 50% but less than 75% minority students (M = 2.4, computer use once or twice a month). Schools with less than 25% minority students had a higher frequency of computers to read, write, or spell than schools with 50% but less than 75% minority students.

In the West, schools with 50% but less than 75% minority students (M = 4.3, computer use once or twice a week) had a higher frequency of computer use to read, write, and spell than schools with 75% or more minority students (M = 4.0, computer use once or twice a week) and schools with 25% or less minority students (M = 3.5, computer use once or twice a week).

Estimated marginal means revealed that schools in the Northeast with a minority population of 50% or more but less than 75% had a higher frequency of computer use to learn math (M = 5.0, computer use three or four times a week) than schools with more than 75% minority student population (M = 3.2, computer use two or three times a month) and less than 25% minority population (M = 3.1, computer use two or three times a month). Schools with 75% or more minority population use computers to learn math slightly more than schools with less 25% minority population.

In the Midwest, schools with 75% or more minority student population (M = 4.0, computer use once or twice a week) had a higher computer use to learn math than schools with 50% but less than 75% (M = 3.6, computer use once or twice a week) and schools with less than 25% minority population (M = 3.5, computer use once or twice a week).

In the South, schools with 75% or more minority population (M = 4.1, computer use three or four times a week) had a higher frequency use of computers to learn math than schools with less than 25% minority student population (M = 4.0, computer use once or twice a week) and schools with 50% but less than 75% minority student population (M = 2.3, computer use once a month or less). Schools with less than 25% minority students had a higher frequency of computers to learn math than schools with 50% but less than 75% minority population.

In the West, schools with 50% but less than 75% minority population (M = 4.5, computer use three or four times a week) had a higher frequency of computer use to learn math than schools with 75% or more minority population (M = 4.1, computer use once or twice a week) and schools with 25% or less minority population (M = 3.3, computer use two or three times a month).

Estimated marginal means revealed that schools in the Northeast with a minority student population of 50% or more but less than 75% had a higher frequency of computer use to learn science concepts (M = 3.0, computer use two or three times a month) than schools with 25% or less minority student population (M = 1.6, computer use once a month or less) and 75% or more minority student population (M = 1.0, not ascertain and/or never). Schools with 25% or less minority population used computers to learn science concepts more than schools with 75% or more minority student population.

In the Midwest, schools with 25% or less minority student population (M = 2.1, computer use once a month or less) had a higher computer use to learn science concepts than schools with 75% or more minority student population (M = 1.9, computer use once a month or less) and schools with 50% but less than 75% minority student population (M = 1.5, computer use once a month or less). Schools with 75% or more had a higher frequency of computer use to learn science concepts than schools with 50% or more but less than 75%.

In the South, schools with 25% or less minority student population (M = 2.7, computer use two or three times a month) had a higher frequency use of computers to learn science concepts than schools with 75% or more minority student population (M = 2.3, computer use once a month or less) and schools with 50% but less than 75% minority student population (M = 0.9, computer use never). Schools with 75% or more minority students had a higher frequency of computers to learn science concepts than schools with 50% but less than 75% minority population.

In the West, schools with 50% but less than 75% minority student population (M = 2.0, computer use once a month or less) had a higher frequency of computer use to learn science concepts than schools with 25 % or less minority student population (M=1.8, computer use once a month or less) and schools with 50% or more but less than 75% minority student population (M=1.5, computer use once a month or less). School with 25% or less had a slightly higher frequency of use of computers to learn science concepts than schools with 50% or more but less than 75% minority population.

Computer use to read, write, and spell had the highest frequency among schools having 50% or more but less than 75% minority students in the Northeast whereas the West regardless of percent of minority student enrollment and the Midwest followed in computer use frequency. The lowest frequency of computer use was found among schools having 50% or more but less than 75% minority students in the South.

Computer use to learn math had the highest frequency among schools having 50% or more but less than 75% in the Northeast whereas the West regardless of percent of minority students and the Midwest followed in computer use frequency. The lowest frequency of computer use was found among schools having 50% or more but less than 75% minority students in the South.

Computer use for science concepts had the highest frequency among schools in the West and Midwest regardless of percent of minority student enrollment. The lowest frequency of computer use was found among schools having 75% or more minority students in the Northeast and in schools having 50% or more but less than 75% minority students in the South.

The South had the lowest percentage of computer use for schools that had a minority population of 50% or more but less than 75% at 5% computer use to read, write, and spell. The South had the lowest percentage of computer use for schools that had a minority population of 50% or more but less than 75% at 5% computer use to learn math. The Northeast for schools having a minority population of 75% or more and the South for schools having a minority population of 50% or more but less than 75% had the lowest percentage of computer use at 0% computer use for science concepts.

Discussion

A statistically significant difference was found in computer use as a function of percent of minority student enrollment and region of the country. Follow-up univariate analyses for computer use as function of percent of minority student enrollment and region of the country yielded three statistically significant differences. These differences were found in computer use to read, write, and spell, to learn math, and for science concepts.

According to Papert (1997) and Ravitch (1993), the increased purchasing of technology and wiring for schools was thought to create a transformation of schooling and to bring more equity in the access of technology use for students of disadvantaged groups. Regional use of computer use (e.g., to read, write, and spell, to learn math, and for science concepts) for minority children was lowest among schools in the South. Schools with a minority student enrollment of 50% or more but less than 75% had the lowest frequency of computer use ranging from computers to read, write, and spell usage of once a month or less, computers to learn math usage of once a month or less, and computers for science concepts usage of never. These findings support the findings of Hoffman and Novak (1998) where use of technology among minority groups has not increased over time but has decreased. Brown et al. (2001), Fueyo (1997), Harrell (1998), Harris (2000), Tumposky (2001), and Woodward and Cuban (2001) have stated that differences to access to current technologies are based on race, gender, geography, economic status, and physical ability. These findings contradict Brown et al. (2001) in which they stated that computer access should increase in the classroom to achieve equity in computer use. The results of these analyses were differences of computer use based on geography and percent of minority student enrollment (i.e., race).

Clearly this research could be extended to students enrolled in upper elementary grades, in middle schools and in high schools. Whereas an argument could be made that kindergarten children are limited in their ability to benefit from technology access and use, that same argument would not hold for children in upper elementary grades, in middle schools or in high schools. Should these findings be replicated in studies of upper elementary students, middle school students, or for high school students, then clearly a case for inequity in technology use could be made. Given the importance of technology knowledge and skills in today's society, research in this area is warranted.

Another area of research would be into socioeconomic factors of the student population that relate to technology access and use. Statistics from the National Center for Educational Statistics (2000) demonstrate that only 39% of instructional classrooms in schools that have 70% or more of the student population on free or reduced lunch have access to the Internet. To what extent do these findings generalize to different ethnic groups and to different regions of the country and to different school locations?

Another recommendation for further research is the resource allocations of schools. In the Early Childhood Longitudinal Study-Kindergarten administrator questionnaire, questions are asked about the number of computers and how these computers are used, for administrative purposes and/or instructional purposes. An examination needs to be made in terms of the percent of monies allocated for technology in the overall budget of the school. Comparisons of money allocation need to occur along the lines mentioned above, percent of minority student enrollment, region of the country, and school location.

Although the Early Childhood Longitudinal Study administrator questionnaire does not address the question of number of computers in the classroom, an investigation needs to occur into the number of computers in the classroom, the age of these computers, and the multimedia capability. Simply because computers might be available in the classroom does not mean they are able to meet the hardware needs of current instructional software.

Finally the last recommendation would be the type of software used in the classroom. Faltis and DeVillar (1990) have stated that most computer use (software) by minority children is geared for drill and practice. A closer of examination of software use will help determine if computer use is for drill and practice or to develop critical thinking.

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