Teachers and Technology Equity

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According to the CEO Forum Report (1997), individual educators are the deciding factor in whether technology is successfully integrated into classrooms and schools. *What you do matters.* The literature identifies three important issues that we as educators must address as we integrate technology into our classrooms (see box, "What Does the Literature Say?"):

- Increasing access to technology.
- Appropriate instruction and use of technology.
- Barriers to institutional technology.

If we are to increase technology access and use with students from diverse ethnic backgrounds, we must be aware of these issues and work actively within our schools to rectify the existing inequities.

Issues

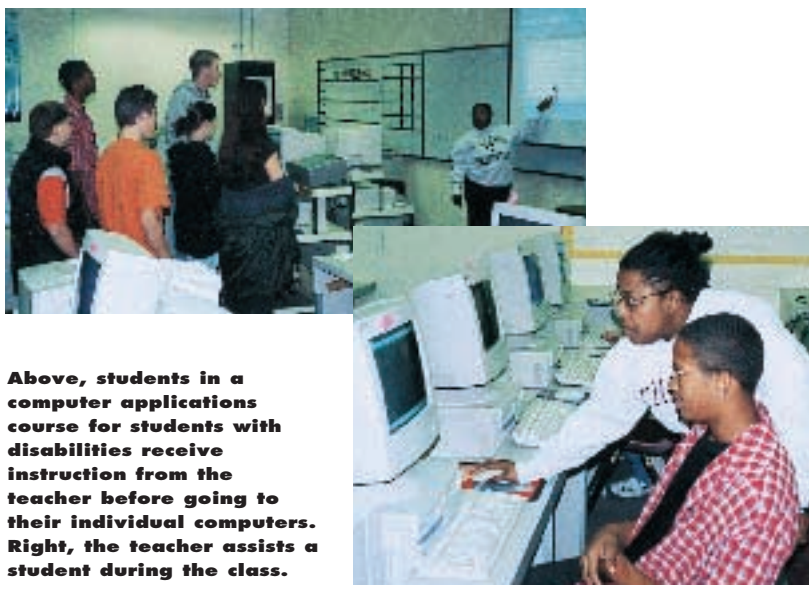
Physical Access and Use

Schools attended by students from families living in poverty or students from diverse ethnic backgrounds tend to offer less access to most types of technology (Coley et al., 1997; ETS, 1997; Henry, 1997). The ETS and Coley et al. also found that once the technology is placed in schools with greater numbers of students from diverse ethnic backgrounds and students receiving Title 1 services, regardless of the types of students (e.g., African American, Asian, Hispanic, or Native American origin), educators typically place the computers and other devices in areas where students have limited access to them (e.g., administrative offices, library and media centers, and computer labs). These findings appear to corroborate the NCES (1995) findings that, in schools attended by students from diverse ethnic backgrounds and students from families living in poverty, educators place computers in the classrooms only 38% of the time.

Wolfe (1986) also found evidence that students from diverse ethnic backgrounds and students from low-income families have similar problems gaining access to technology. She also identified bilingual students and students with special needs as having the same problems with technology access. This lack of physical access in schools has not changed over time. According to Wolfe, students from diverse ethnic backgrounds, students who live in poverty, bilingual students, and students with disabilities have the least access to technology in their schools.

Instruction and Pedagogy

Also at issue is whether educators teach similar or different technology applications to students from different segments of society. A strong relationship exists between the type of student who is being educated using technology and the type of instruction they are receiving (Anderson et al., 1984; Kozma & Croninger, 1992; Mehan, 1985). Students from diverse ethnic backgrounds from lower economic backgrounds received instruction in which the computer maintained control of the learning (e.g., computer-aided drill and practice), whereas white students received instruction involving technology that



Above, students in a computer applications course for students with disabilities receive instruction from the teacher before going to their individual computers. Right, the teacher assists a student during the class.

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What Does the Literature Say About Technological Equity?

The inequities that exist concerning technology access in the home and at school contribute to a large segment of school-aged children and youth from diverse ethnic backgrounds being considered at risk for school failure (Coley, Cradler, & Engel, 1997; Henry, 1997; Holloway, 2000; LaPointe & Martinez, 1988; Lewis, Harrison, Lynch, & Saba, 1995; Wilhelm, 1998; Wilhelm & Rood, 1996).

The literature on equitable access and use of technology has indicated that many students have been hindered by inequitable access to technology within the school environment—including students from diverse ethnic backgrounds, students living in inner cities, female students, students with disabilities, rural children, English language learning (ELL) children and their families, and students unlikely to graduate or who leave school without an adequate level of basic skills (American Library Association (ALA), 1998; Anderson, Welch, & Harris, 1984; Becker & Sterling, 1987; Davis & McCaul, 1990; Milone & Salpeter, 1996; Neuman, 1991; Sutton, 1991).

Chambers and Clarke (1987) suggested that the inequities in students' computing experiences may disadvantage students with less technology experience in three ways:

- Their ability to function as citizens in an increasingly technological society.
- Their capacity to gain adult employment.
- Their development of general cognitive skills and positive attitudes toward learning.

In 1995 the U.S. Department of Commerce reported that white students were two to three times more likely to have home access to technology than African American and Hispanic students, and as much as three to six times more likely than students from rural, urban, and central-city areas, regardless of their ethnic backgrounds. In a follow-up study in 1998, the U.S. Department of Commerce found that although more people in the United States than ever have access to computers, the gap between those with access to information technologies persists and has widened over the past several years (see Table 1). In addition, the National Center for Education Statistics (NCES, 1997) found that white students have greater access to and use of technology at school than do African-American and Hispanic students. It appears that this disparity has only grown over time.

The literature identifies three issues of importance for educators as they attempt to integrate technology into their daily classroom teaching (Becker & Sterling, 1987; Cummings, 1998; Educational Testing Service (ETS), 1997; Henry, 1997; Martinez, 1994; Neuman, 1990; Rogers, Honig, & Ambach, 1991; Sutton, 1991; Wolfe, 1986). These issues are (1) increasing access to technology, (2) appropriate instruction and use of technology, and (3) barriers to institutional technology (e.g., stereotypes held by female students, lack of role models, lack of adequate materials).

Table 1. Percentage of U.S. Households with Computers by Race/Origin and Geographical Areas

Race/Origin	Urban		Rural		Central City	
	1995	1998	1995	1998	1995	1998
White-non-Hispanic	24.6	48.5	30.3	42.0	29.4	47.4
Black-non-Hispanic	6.4	23.8	11.8	17.9	10.4	21.8
Hispanic	12.0	25.7	13.2	23.2	10.5	21.4
American Indian	15.3	38.7	23.7	26.8	25.5	35.6
Asian or Pacific Islander	33.7	55.6	39.5	40.6	35.9	50.5

Sources: U.S. Department of Commerce. (1995). *Falling through the Net: A survey of the "have-nots" in rural and urban America.* [On-line]. Available: http://www.ntia.doc.gov

U.S. Department of Commerce. (1998). *Falling through the Net II: New data on the digital divide.* [On-line]. Available: http://www.ntia.doc.gov

encouraged learner initiative (e.g., problem-solving). Crist-Whitzel (1985) reported that disparities in teachers' attitudes toward technology access and use do exist and that these attitudes affect the types of instruction provided for students who are from diverse ethnic backgrounds, low achieving, or living in poverty. It appears that the quality of the technology application offered to students who differ in social class and ability is limited to technology that controls student learning, rather than technology that the students learn to control.

There is also little instructionally sound software available to meet the needs of students from diverse ethnic backgrounds (Warner, 1998; Webb,

1986), students with disabilities (Lewis et al., 1995), female students, and students who have been identified as at risk (Crist-Whitzel, 1985). Hearne, Poplin, Schonenman, and O'Shaughnessy (1988) noted that when technology is used with students from diverse ethnic backgrounds, educators seem to place more emphasis on remediation that results in a less-challenging curriculum. This is reflected in the selection of software that focuses on the repetition of content through drill and practice, thus denying students from diverse ethnic backgrounds the opportunity to learn higher-level thinking skills. In addition, software that is currently available does not allow these students to see themselves represented in the software, just as they have not seen themselves represented in textbooks and children's literature for the past 20-30 years (Beaty, 1997; Biraimah, 1989; Creany, Couch, & Caropreso, 1993; Ikegulu, 1997; Kirova-Petrova, Bhargava, & McNair, 1999; Valentine, 1996).

Recognizing Barriers

School personnel have the responsibility to ensure equitable access for all students by identifying and removing any biases from the use of technology. Wolfe (1986) found that students from diverse ethnic backgrounds and female students hold stereotypes (e.g., technology is for male students, they cannot have careers in the technology field) concerning technology that interferes with their use of the technology as a tool for education, recreation, artistic expression, informational organization, and problem-solving.

Other barriers include

- The lack of role models at home and at school (McInerney & Park, 1986).
- Students' assignment to academic tracks offering less access to technology (Becker & Sterling, 1987).
- Unconscious stereotyping by educators that keeps students from diverse ethnic backgrounds from being academically challenged (Kozma & Croninger, 1992).
- Poor supervision of technology use (McInerney & Park, 1986).
- Race, gender, ethnic, or language biases and stereotypes that may be present in the software being used (Webb, 1986; Wolfe, 1986).

LITTLE INSTRUCTIONALLY SOUND SOFTWARE IS AVAILABLE TO MEET THE NEEDS OF STUDENTS FROM DIVERSE ETHNIC BACKGROUNDS, STUDENTS WITH DISABILITIES, FEMALE STUDENTS, AND STUDENTS WHO HAVE BEEN IDENTIFIED AS AT RISK.

Creating Technology-Rich Schools for Students from Diverse Ethnic Backgrounds

Riley, Kunin, Smith, and Roberts (1996) have described technology-rich schools as those in which

- Parents, students, and school leaders have collaborated to create "learner centered" environments that focus on how technology can support students' individual needs and capabilities.
- Educators clearly state goals and challenging standards.
- The school has restructured to support the learner-centered environments and the achievement of standards.
- The school offers near-universal access to technology.

Educators in these schools have made an effort to consider the population of students within the school when creating their technology-rich environments. They have evaluated the computer-using teachers in the school to determine which students receive more or less instruction (Becker & Sterling, 1987), and they have communicated with large corporations to obtain donations of technology. Riley et al. (1996) stated that technology-rich schools produce the best results for students because the classroom focus is on the learner and the provision of technology to support his or her individual needs.

SCHOOLS ATTENDED BY STUDENTS FROM FAMILIES LIVING IN POVERTY OR STUDENTS FROM DIVERSE ETHNIC BACKGROUNDS TEND TO OFFER LESS ACCESS TO MOST TYPES OF TECHNOLOGY.

Chisholm (1995) stated that educators must create culturally responsive and equitable learning environments wherein all learners may be successful. As educators, we must provide students from diverse ethnic backgrounds the same opportunities to achieve the level of excellence that educators afford white or native-English-speaking students. Wenglinsky (1998) reported that students from diverse ethnic backgrounds had differences in their experiences with computers and technology-related courses when compared to their white peers. He also reported differences between boys and girls.

When provided with multiple access routes to information (e.g., e-mail, World Wide Web, electronic databases, and libraries), all students can access knowledge in the classroom. Once we design teaching and learning experiences around technologies that are adaptable to respond to the diversity among students, then students can engage in active and independent exploration. The common thread in successful technology-education programs of students from culturally and linguistically diverse backgrounds must include strategies involving individualized technology instruction, including the following:

- The use of technology in special education classes.
- Smaller classes.
- Parental involvement.
- Homework involving technology.
- Thinking skills.
- Motivation.
- Empowerment.

(See box, "Tips for Creating Technology-Rich Schools and Classrooms.")

Tips for Creating Technology-Rich Schools and Classrooms

1. Use e-mail, satellite-delivered instruction, or Web-based instruction.
2. Allow students access to electronic databases and libraries (Riley et al., 1996).
3. Use multimedia software for instruction.
   - Use interactive video to connect school-based learning to real world situations (Kozma & Croninger, 1992).
   - Use interactive multimedia (e.g., graphs, pictures, and sounds) to allow students to see information simultaneously represented in several linked systems (Kozma & Croninger, 1992).
4. Make adjustments to the curriculum and classroom.
   - Reschedule computer time to fit it into the curriculum (e.g., have groups of students working on computers while the rest of the class gets whole-class or individual instruction. Make technology an integral part of the instructional process).
   - Redesign the classroom (e.g., locate computers so that they are visible from all areas of the room, not just in the corners or behind the teacher's desk).
5. Find ways to use technology after school. For example, keep labs and classrooms open after school hours.
6. Find ways for the school community to use the technology. Offer evening and weekend technology courses for the community
7. Allow educators time to learn how to integrate technology into their instruction.

How Educators Can Confront the Issues

Increasing Technology Access

Students from diverse ethnic backgrounds often are restricted to the use of technology during limited school hours and usually do not have access to computers in their homes (Becker & Sterling, 1987; Henry, 1997). Because of the inequities faced by these and other students (e.g., female students, students with disabilities, and students with differing academic abilities), they warrant greater access to technology than students who are not faced with inequities (Neuman, 1990). Coley et al. (1997)

Increasing Technology Access: Suggestions for Educators

- Create mini-labs throughout the building (McKenzie, 1998).
- Have roving computer stations that stay in classrooms for extended periods of time (McKenzie, 1998).
- Create computer labs for each department (e.g., math, science, English, special education).
- Offer and allow typically underserved students opportunities to take technology courses and earn credit toward graduation.
- Encourage all students to join technology clubs (e.g., ones that meet during lunch or other noninstructional times of the day).
- Encourage students to use technology on their own time and for their own purposes.
- Have girls' technology day, use female students, and students from diverse ethnic backgrounds as technology monitors, and have more sign-up slots for female students during free time.
- Encourage all students to attend summer technology camps (Wolfe, 1986).
- Develop funding formulas that equalize technology spending across rich and poor districts (Education Commission of the States, ECS, 2000).
- Lend laptop computers to students, much as band students receive musical instruments (Education Commission of the States, 2000).
- Ensure equal technology use, regardless of gender, ethnicity, or achievement level by removing some of the biases and stereotypes associated with technology use (Martin, 1990; Wolfe, 1986).
- Target all students for higher-level cognitive skills by having them use more problem-solving tools and learn programming (Emihovich, 1992).
- Consider summer school courses that meet at atypical times (e.g., evening, weekends) to accommodate students who work after school.
- Blend technology into the daily routine to promote learner-centered environments.
- Schedule individual and group time for students.
- Offer evening classes to involve parents and other community members.
- Encourage students to take training classes in the use of computers (ALA, 1998).
- Make computers available to the public through schools, libraries, and community centers (ECS, 2000).
- Encourage your school to develop partnerships with public libraries (ALA, 1998).
- Encourage students to use public library technology for after-school homework assistance and to take advantage of mentoring and tutoring programs (ALA, 1998).
- Consider extending the schools' hours (ECS, 2000).
- Create partnerships with universities to establish apartment schools in neighborhoods where access is limited (Hentschke & Salverson, 1993; Lovitt, 1995; Lovitt, Perry, & Hughes, 1996).

WE NEED TO PROVIDE ROLE MODELS AND CULTURALLY SENSITIVE SOFTWARE, AS WELL AS EXTENDED SCHOOL HOURS FOR COMMUNITY USE OF TECHNOLOGY.

reported that the students with the most need get the least access.

Ensuring this equity involves more than just equal allocation in the school, because these students do not have the same access outside of school. We must seek creative methods to increase technology access for these students during school hours, as well as after school. In addition, public libraries and community centers may be in a position to address inequities in access (ALA, 1998). These institutions need to dedicate more resources toward technology and toward publicizing the available resources.

We can increase students' access to technology in many ways, such as the following:

- Locate computer labs within the school so that they are accessible to all students.
- Promote technology use by different groups of students (e.g., female students, students from diverse ethnic backgrounds, students with disabilities, and students who are English language learners).
- Promote quality access for all students.
- Promote equitable scheduling of computer time.

TECHNOLOGY-RICH SCHOOLS PRODUCE THE BEST RESULTS FOR STUDENTS BECAUSE THE CLASSROOM FOCUS IS ON THE LEARNER AND THE PROVISION OF TECHNOLOGY TO SUPPORT HIS OR

- Promote public library usage (ALA, 1998).

(See box, "Increasing Technology Access.")

Effective Technology Integration and Instruction

Hadley and Sheingold (1993) suggested that technology is most valuable to teaching and learning once teachers integrate it as a tool into everyday classroom practice and into subject-matter curricula. It is only through integrated practices, however, that we can realize the hopeful and idealistic claims for technology (Collins, 1991). One of the major challenges is to provide effective technology instruction that attends to both similarities and differences in the needs of students from various linguistic and cultural backgrounds (Ward & Tikunoff, 1994). Such instruction requires us to readily and flexibly incorporate technologies into our everyday practice in relation to the subject matter they teach (Hadley & Sheingold, 1993). Incorporating technology effectively involves

- Engaging students in active learning.
- Relying less on whole-group instruction.
- Encouraging more independent and self-motivated learning.

(See box, "Improving Technology Integration and Instruction.")

Removing Barriers

School personnel can ensure equitable access for all students by learning to identify and then remove biases or barriers (e.g., technology is only for male students, students from diverse ethnic backgrounds can have careers in the technology field) that may exist that prevent the students from accessing and using technology. We must recognize the barriers that are intrinsic within the school environment, as well as the fact that students from diverse ethnic backgrounds and female students hold stereotypes and fears concerning technology that must be addressed before these students can actively access and use the technology (Webb, 1986; Wolfe, 1986).

We can begin to remove some of these barriers by

- Providing students with a variety of applications, educational games, and problem-solving software.
- Recognizing built-in biases and stereotypes in software.
- Providing a well-developed literacy curriculum.

(See box, "Removing Technology Barriers.")

Final Thoughts

Equity signifies providing for the specific needs of each child so that all children have an equal opportunity to succeed. Because children differ in their knowledge, skills, abilities, learning styles, and cultural backgrounds, their educational needs are also different. Therefore, we as educators must ensure that all students have access to the instructional programs and activities that help them develop their own potential. These programs increasingly involve technology.

As educators, we must work actively to adjust our attitudes, as well as student attitudes, toward technology. Everyone who works in a school must be actively involved in equitable access to technology: We must purchase appropriate software, keep the school open during nonschool hours, further our own technology education, work with parents to help them learn the technology, and keep the school administration abreast of the capabilities of the new technologies. Technological equity is not the sole responsibility of the state, central office, or even school administrators. By being proactive and creative, educators can begin to lessen the technology gap that exists in and out of school for students from diverse ethnic backgrounds.

INDIVIDUAL EDUCATORS ARE THE DECIDING FACTOR IN WHETHER TECHNOLOGY IS SUCCESSFULLY INTEGRATED INTO CLASSROOMS AND SCHOOLS.

Improving Technology Integration and Instruction

Tips	Suggestions for Educators
1. Identify individual school and/or classroom variables when attempting to integrate technology into the school or classroom.	• Determine each teacher's level of expertise with technology. • Determine what types of students make up the student body of the school or classroom (e.g., low-achieving, limited-English-speaking, female students, students from diverse ethnic backgrounds).
2. Allow the school culture to shape how the technology is used.	• Consider creating programs where the students can take the technology home. In this manner, access is increased at home and parents are exposed to the technology.
3. Use drill and practice to augment basic skills instruction in special needs classrooms (Bahr & Reith, 1989).	• Make sure drill and practice is used to enhance talents, not just remediate deficits (Hearne et al., 1988).
4. Match and integrate the capabilities of technology with the social and curricular arrangements of the school so that technology can contribute to the lives of all the students (Kozma & Croninger, 1992).	• Use computers in conjunction with collaborative groups of students that are organized around goal-oriented tasks (Laboratory of Comparative Human Cognition (LCHC), 1989). • Include tasks that involve rich, interactive simulations. These microworlds should embed the need for basic skills in higher-order thinking (LCHC, 1989). • Use technology to connect students to family, the community, and other cultures, particularly those in which their ethnic and language characteristics are dominant (LCHC, 1989).
5. Use technology effectively. Integrate the capabilities of the media with pedagogical practices.	• Use technology to ask students questions, evaluate student progress, pace instructional goals, and interact with students (Kozma & Croninger, 1992).
6. Raise teacher awareness about equity.	• Schedule informal day-to-day discussions and/or formal presentations. • Schedule speakers for inservices and other programs. • Schedule informational sessions designed to address the problems and possibilities for equity in the implementation of new technology in the school. • Schedule ongoing staff development for teachers and administrators to provide training in the uses of technology and working with diverse student populations (Webb, 1986).

Removing Technology Barriers: Suggestions for Educators

- Choose software that reflects the student population and educational goals of the program.
- Choose software that guarantees success and avoids negative stereotypes.
- Match the software to the material to be taught (Wepner, 1991).
- Provide criteria in the selection of software (Kirova-Petrova et al., 1999).
- Be sensitive to cultural, ethnic, and racial diversity when developing educational software and digital content (ECS, 2000; Miller, 1996).
- Focus on the issues concerning the instruction of students from typically underserved populations.
- Invite guest speakers who will serve as role models for students from diverse ethnic backgrounds and non-English speaking students.
- Provide software in the language of the students.
- Find software that meets the needs and special interests of all students (e.g., instructionally sound simulations that incorporate the culture and/or language of the students).

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