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ABSTRACT

This edition of "Equity Coalition" is designed to be a resource to assist those who have responsibility for technology in the schools. The authors of these articles discuss a variety of issues related to computer uses in education and equal access to educational technology. The issue contains the following articles: (1) "Technology--A New Kind of Literacy" (Percy Bates); (2) "Loving the New: U.S. Culture and Computers Equity" (Eleanor Linn); (3) "Tomorrow's Jobs: How High-Tech Are They?" (Eleanor Linn); (4) "Equitable Software Design: An Interview" (Brenda Matthis and Salome Gebre-Egziabher); (5) "Culture and Computer Technology in the Classroom" (Martha A. Adler); (6) "Gender, Equity, and Computer Technology" (Eleanor Linn); (7) "Parents, Computers, and Telecommunications" (Elizabeth M. Mimms); (8) "Guidelines for Selecting Equitable Software" (Marta Larson); (9) "On the Road to Cultural Bias: A Critique of 'The Oregon Trail' CD-ROM" (Bill Bigelow with Marta Larson); (10) "Unequal Computer Access and the Achievement Gap" (Ted Wilson); (11) "Successfully Merging onto the Information Super-Highway" (Tasha Lebow and David Dugger); and (12) "Recommended Resources for Computer Equity at School" (Eleanor Linn and Ted Wilson). (SLD)

Computer Equity @ School

University of Michigan School of Education
Ann Arbor, Michigan

EQUITY COALITION

For Race, Gender, and National Origin

Computer Equity @ School

Technology—A New Kind of Literacy

Percy Bates, Director, <pbates@umich.edu>

WHY are we concerned about computer equity at school? Because schools have long tolerated inequities in discipline, resources, athletic participation, and student achievement within their walls, and now technology must be added to the list of gaps that need attention. In the rush to install technology, schools have ignored differences in access and differences in how well prepared teachers are to use computers in their classrooms. Hence, we are turning our attention in this issue of *Equity Coalition* to computer equity at school.

Photo by Marilyn Nolt, Souderton, PA

The ability to use computer technology has become a new kind of literacy which our children must master if they are to become productive, successful citizens, just as they must learn to read and write. As we continue to work together to close the achievement gaps among school-age children in the traditional areas of literacy, we should be mindful of this new area of literacy.

From our vantage point it is difficult to see how anyone in our society can avoid the influence of computer technology in everyday life. There was a time when only those who had a professional interest in technology had to learn anything about it. We have long passed that point. As we prepare students for the future, we must assure that every student has access to computers and good teaching so as to become a confident, self-sufficient user. Some students may want to pursue professional roles where a high degree of knowledge and training in computers and technology will be required, but every student should learn enough about technology to be able to choose whether to become a user or a 'techie.' Whatever their bent, all students will need equal access to networked computers and to teachers who are well prepared and who have the support necessary to teach all students how to use technology intelligently.

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A New Kind of Literacy

(continued from page one)

This issue of *Equity Coalition* is designed to be a resource to assist those who have responsibility for technology in our schools.

Who will foot the bill for computers and how will they be used? is the question posed by Eleanor Linn. She also talks about tomorrow's jobs and how computers will be utilized in those jobs.

Brenda Matthis as interviewed by Salomé Gebre-Egziabher discusses the issue of equity in software design and the importance of opportunities for students to interact with the software and learn to make decisions.

Martha Adler describes the importance of approaching computer technology within the context of the culture of the children and at the same time of recognizing cultural differences.

Eleanor Linn returns to the stage and reminds us that gender equity is a very important aspect of computer technology and can be used to expand children's gender roles.

Elizabeth Mimms reminds us that parents play an early and significant role in guiding young children as they prepare themselves for the future.

Marta Larson provides useful guidelines for selecting equitable electronic materials.

Bill Bigelow cautions us about the potential for cultural bias that may exist in some software and about the need to equip students with the ability to differentiate between various kinds and types of software as to its content.

Ted Wilson discusses computer access and its relation to the achievement gap and stresses the need to understand that technology alone will not raise achievement or reduce the achievement gap.

Tasha Lebow and David Dugger describe the principles and strategies by which schools can merge onto the information superhighway.

A list of recommended resources is provided for the reader by Eleanor Linn and Ted Wilson.

As we move into the future with greater and greater speed, expanded memory, and more information than we have ever had, we are hopeful that this publication will help to bring about "computer equity@school."

Computer Equity @ School

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Director: Dr. Percy Bates; *Editor-in-Chief:* Eleanor Linn; *Editor:* Ted Wilson; *Art Editor:* Tasha Lebow; *Editorial Board for this issue:* Marta Larson and Elizabeth M. Mimms.

Loving the New: U.S. Culture and Computer Equity

Eleanor Linn, Senior Associate Director, <elinn@umich.edu>

DETERMINING how computers will be used and who will pay for them is probably the most important political and moral decision of our era. The issues involved are complex and reliable information is scant. Large sums of money are at stake and missed opportunities may imperil the adult lives of the children who are our students today. There is no simple answer to personal decisions about computer use. Still more complex are the political and moral decisions about whether or how to regulate computer use in schools, and how we will subsidize the cost to ensure their fair use by children from all groups in our democracy.

Unfortunately, we seem to be in the midst of making these important decisions by default, rather than by conscious intent. Large technology companies are shaping the debate through advertising and indirect influence on the information available to us. Their implicit message is that everyone needs computers, the more the better. Parents fear their children will be left behind if they don't buy them a computer to use at home. Without knowing how it will help children learn or prepare for the world of work, many strongly believe that a computer in every classroom would improve student achievement (Rose et al., 1997). Love of technology is basic to our mainstream culture.

What Is Technology?

Technology is broadly defined as the totality of things and methods that people have made (Rothenberg, 1993). It can be contrasted to the things that are part of nature, though philosophers warn us there is considerable overlap between technology and nature. Computer technology, the kind of technology that uses electronic computer-based processes, is also an extension of human culture. It is invented, used, and changed by economic, social, and psychological forces in our culture. If we understand these forces, we can understand the problem of equity and computer technology that we face in our schools today (Feenberg and Hannay, 1995).

U.S. Love of Technology

Mainstream U.S. culture, perhaps more than the culture of any other industrialized country, is in love with technology. Many Americans believe that most problems can be solved through hard work, persistence and technological know-how. Not just industrial problems, but medical, psychological, and social problems are addressed in our culture in technological ways. We study the cause of a problem long enough to work out a mechanism for fixing, or improving it. For problems we haven't solved, such as poverty, discrimination, or a cure for cancer, many of us believe that the cause has not been well enough identified, that the mechanism is not well understood, or that the remedy is not yet potent enough, but that a solution will eventually be found.

Our belief in technology has given us a strong sense of optimism and an enormous degree of energy for personal and social improvement. While these characteristics may make us look naive to people in other cultures, it has helped us invent many useful and practical devices, of which we are very proud. It has also driven our general economic productivity, which has increased the standard of living for many, though not all of our citizens.

We give people who embrace technological improvement high status, so others aspire to be like them. Owning and using new technology gives people power and status beyond the power of the technology itself.

Lessons from History

The way we interpret our history is also influenced by our love of technology. Karl Marx said, "The hand-loom gives you society with the feudal lord; the steam-mill, society with the industrial capitalist" (1936). While little else he wrote is quoted frequently, his belief that technology determines economic and social relationships is widely shared. We ignore Marx's prediction in the same essay that constructing the railway in India would destroy the Indian caste system. It didn't.

Technological changes have influenced cultural practices in unpredictable ways, for example, air conditioning in the Deep South or the cotton gin in New England. However, useful technologies have sometimes been rejected because the people who used them were social outcasts, or because the society refused to make social changes to accommodate them (Smith and Marx, 1994). What's more, the same technology may be adopted in different ways by different cultures.

Alan Toffler's *Third Wave* and John Nesbitt's *Megatrends* predicted that the electronic age

would bring greater decentralization, citizen participation, and equality of access. However, I believe that computer technology will not erase social injustice by making information more available to everyone. If we want our culture to be more equitable, we must work together to make it so. Otherwise only the privileged will have the money, the knowledge, the necessary attitudes, and the time to use computer technology.

Rejecting Technology

Along with our ridicule of the last horse and buggy driver (cars were supposed to be so much cleaner) is our retelling of the story of the Luddites. They were nineteenth-century English textile workers who destroyed their employers' weaving machines because they were against having their work de-skilled and their working conditions decline. They lost the struggle because the mill owners could easily hire other low-paid workers to replace them. The moral we give their story is significant for what it says about us. We portray the Luddites as naive, short-sighted, and almost predestined to lose. We devalue the contributions of people who question technological change and protect their pride in skilled labor.

> Computer technology will not erase social injustice by making information more available to everyone. If we want our culture to be more equitable, we must work together to make it so.

Modern day Luddites may be living in our communities. They may have become unemployed or lost wages or benefits as a result of automation, or jobs moving abroad. Automotive workers, bookkeepers, drafters, seamstresses may be happily retrained, or they may be embittered by technological change that was made without their consent. They may be the parents of children in schools, voters or abstainers in our elections. Their voices are part of the great unheard conversation about technology. We need to listen to what they have to say and their ideas for making a fairer world.

Reframing Our Love of Technology

Technologies are not merely ways to make work easier, writes philosopher of technology Langdon Winner, "they are powerful forces acting to shape that activity and its meaning." Our attitude toward technology can ultimately influence how we see ourselves. The work of Ralph Nader, Rachel Carson, and Helen Caldicott, who all focused on restraining technology and uncontrolled profit in the service of health and well-being can provide us with strong examples of popular political control of technology. It is possible to make technology into a public and social good, if we organize to do so. We can also distribute it more fairly and wisely to the children in our schools.

Back in the 1980s when computer related employment was growing so quickly that labor analysts predicted it soon would be as large and well paid as engineering, schools with the money to do so rushed into buying equipment and pushed students labelled "most likely to succeed" into programming classes. Now it seems that with simpler operating systems and easy-to-use software nearly all workers will use some computer technology, but only a small number will need to know programming, design or repair (Bureau of Labor Statistics, 1999). What's more, the specific skills needed to operate a computer today may not be helpful in using the computer technology of the future. Thinking and organizing skills (see Lebow and Dugger in this issue) may well be more important in preparing children for the work force of tomorrow. So will teamwork, communication, persistence, and flexibility.

We have important decisions to make if we want to ensure equity in the lives of our children. We need to provide all students with rich environments in which to learn problem solving. We need to support all teachers and parents in helping children become avid learners and doers. We need to make full use of the equity potential of computer technology, but understand and regulate its limitations as well.

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Tomorrow's Jobs: How High-Tech Are They?

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THE U.S. Department of Labor's Bureau of Labor Statistics lists the following 30 occupations as having the largest projected growth in the period 1996-2006. Collectively, they will account for more than 8.6 million new jobs.

Occupation	Number of New Jobs
Cashiers	530,000
Systems analysts	520,000
General managers and top executives	467,000
Registered nurses	411,000
Salespersons, retail	408,000
Truck drivers, light and heavy	404,000
Home health aides	378,000
Teacher aides and educational assistants	370,000
Nursing aides, orderlies, and attendants	333,000
Receptionists and information clerks	318,000
Teachers, secondary school	312,000
Child care workers	299,000
Clerical supervisors and managers	262,000
Database administrators, computer support specialists, and all other computer scientists	249,000
Marketing and sales worker supervisors	246,000
Maintenance repairers, general utility	246,000
Food counter, fountain, and related workers	243,000
Teachers, special education	241,000
Computer engineers	235,000
Food preparation workers	234,000
Hand packers and packagers	222,000
Guards	221,000
General office clerks	215,000
Waiters and waitresses	206,000
Social workers	188,000
Adjustment clerks	183,000
Cooks, short order and fast food	174,000
Personal and home care aides	171,000
Food service and lodging managers	168,000
Medical assistants	166,000

- Three of the occupations involve large amounts of computer knowledge. They account for 1 million new jobs, or approximately 12% of the new jobs projected.
- Eight of the occupations involve considerable understanding of computer applications, but require other kinds of skills as well. They account for 2.6 million new jobs, or approximately 30% of the new jobs projected.
- The nineteen remaining occupations involve few computer skills, or computers may only be used by some workers in specific positions within that occupation. Of those 5 million jobs, 3 million pay low wages.
- That leaves only 20% of the new jobs not requiring much in the way of computer skills, but paying better than low wages. None of them are in the high wage earning category.

There are many other occupations not included in this list. These estimates are just a quick look at how the combination of computer technology skills and other skills may help students prepare for the world of work. The amount of computer knowledge needed and pay levels were estimated by Eleanor Linn from information in the 1998-1999 Occupational Outlook Handbook. The occupational categories and projected number of jobs came from the U.S. Department of Labor's Website: <http://stats/bls.gov.80/news.release/eoh.table2.htm>.

Finally, if you would like your students to consider careers that use computers, consider *Career Ideas for Kids Who LIke Computers*, cited below. This lively book features a diverse group of people in a variety of white collar and blue collar jobs. It is intended for middle-school students as a guide to career possibilities based on their interests and skills with photos and lighthearted biographical sketches of a wide variety of actual, real-life computer professionals.

Reeves, Diane Lindsey, and Kent, Peter. 1998. *Career Ideas for Kids Who Like Computers*. New York: Checkmark Books, an imprint of Facts on File, Inc.

Equitable Software Design: An Interview

Brenda Matthis <matthibr@post.harvard.edu> and
Salomé Gebre-Egziabher, Field Service Specialist, <sge@umich.edu>

BRENDA MATTHIS has been a computer programmer, systems analyst, and software designer since the early days of the computer industry. Her current work is in educational computing, equity, and problems of authorship in software. She is a doctoral candidate and teaching fellow in education software design at the Harvard Graduate School of Education.

Salomé: Can you tell me how you became interested in computer-related work?

Brenda: I love telling this story because it's a story of accidents. Well, I don't believe really in accidents, but, you know, this was not something that I had planned at all. When I graduated from the University of Wisconsin in Milwaukee in '74, I had wanted to go to law school and maybe into labor arbitration. I was living in Wisconsin because that's where I'm from. I wasn't quite excited about law school and I thought, well, I would wait. I would work and then I would go back and try for law school. Well, in the meantime, I got a job at the J. C. Penney Company in their computer programmer trainee program. At that time you could not go to a university or to a school to learn about computers. And I was a business major and, of course, I had to take computers in college but I *hated* it. Oh, boy! I was so glad when that course was over.

All my friends were not getting jobs or were getting laid off because of the recession, and J. C. Penney was hiring people and taking them through their training program. I said, "Well, I'll give it a try." It was a job. It was a well-paying job. It just so happened that they only hired two people to train, usually they had 16, and out of the two, I was the only one who graduated. The other person dropped out.

But I *loved* it! I found that computers and doing software programming in real life were different than doing it in school. There was a real-life application to it, and I found that I had a wonderful aptitude for it.

Salomé: Can you tell us how and why you got interested in equity in software development?

Brenda Matthis, photo by Suzanne Greenberg

Brenda: I moved to Boston to work for the Gillette Company, and then eventually I wound up at Digital Equipment Corporation for 11 years. I loved doing software development and managing projects and going up the ladder. However, I was starting to get dissatisfied because I wanted to do more. I was doing well, but I wasn't doing good. Do you know what I mean?

No one was working for equity in software. They were just taking it off the shelf as soon as someone made it. The most important equity issue, I think, is what I call the action in the software, the decisions that a person, a kid, is allowed to make in the software. What a child is allowed to do or not allowed to do tells that child what the world is like. It reflects the social construction of the world. And that's not necessarily bad or good, but we don't check for these things when we buy the software.

> Our culture is treating software differently, as if it's perfect, and yet it's the most regimented and circumscribed of all the mediums.

The original *SimCity* software was a good example. Its stated purpose is to teach the "rules of city development" (this is stated on the box). The contradiction lies with the absence of a major "rule of city development" regarding taxes. The absence of an explanation is

particularly conspicuous in a game that simulates the capitalist development experience. One could cynically argue that in real life taxes are not explained, but I do not sense that this is in the spirit of the program. One could also argue that SimCity is a game, not to be taken seriously. I cannot disagree strongly enough. The social lessons provided in any game, the songs in a movie, the images in a book, the rhymes shouted while jumping rope, and the implied rules in a software game, all give an impression of what life is, and is not. SimCity states that there are rules to be followed in developing a city, and it teaches you to pay the taxes or you can't play the game, but you will not be taught what the rule is regarding taxes or how taxes support city services.

So my personal goal is to raise the awareness of educators, parents, and the public at large to say, "Be as selective with software as you are with the books that you read, the music that you buy, and the films that you go to." It's the same thing, but for some reason our culture is treating software differently, as if it's clean, or as if it's perfect, and yet it's the most regimented and circumscribed of all the mediums. A software program gives you the impression that you can do what you want to do in there. I have an expression. I say, "You are like rats in a maze" in software. You are in this maze, and they tell you where the cheese is, or where they think you should go, and you think you have free rein! But you don't. You're just going through these little paths that are pre-selected for you.

Salomé: Who gave you guidance or encouraged you, and how can we assist students to make choices that will be helpful?

Brenda: I was in an area where no one could really help me because no one knew anything about it. I just fell into it. However, I will say that what direction and guidance a student gets in high school makes a crucial, *crucial* difference, not so much in deciding what direction the student is going to take, but just in getting themselves prepared so that whatever action they take, they can take it.

When I was in high school, I was an okay student, a B/C but not an A student. During senior year I was in the guidance counselor's office, and she opened up my file in that secret way, and she said, "You know, according to your tests you should have gotten straight A's." Now, the thing is that no one had ever told me what my tests were. If you tell a child that they are doing very well on the tests, they know where they stand and can make corrections. Or if they are not doing as well, let them know where they need to do better, so they can improve by the time they graduate.

Salomé: I think that's a very good story to tell students. It doesn't mean you cannot find success in computers just because you didn't have A's and B's in the school system.

Brenda: I don't know what the statistical data is on it, but I would guess from my experience that there are more middle-of-the-road students than straight A students or failing students. No one pays attention to the middle-of-the-road student, especially the student who is doing really great in one or two things and is doing only okay in others. I had one semester of writing in high school, and I aced that because I found I loved to write, and writing has been one of my great interests ever since. But no one was saying, "Look! This is her gift!" Or "That's where her strength lies. Let's put her in more of that and see how she can move that success into her other areas."

> Bring African-American software professionals, technology professionals, into the schools.

Salomé: Besides giving good advice, what other things can schools do to motivate students to consider subject matters that are not typically associated as areas to be pursued by African Americans?

Brenda: I think one of the most powerful things the schools can do is to bring African-American technical people into the schools to let the kids see that they exist. I've heard it said many times, "You know, there aren't many African-American people in software." Well, there *are* a lot, because I know them. But for some reason people don't know who they are, and they don't get to see them, and because they're not seen, they are not really considered to exist. Also, the software field is not as visible as other fields. You don't see where these people work. They're sort of in the back, in some other building.

There are two wonderful things that teachers can do. One is to bring African-American software professionals, technology professionals, into the school to talk to the students and tell them what they do and how they got there. We all got there in different ways, and there are a lot of us, but people don't know it. The second thing teachers can do is bring the kids to the place where the African-American software person works, so they can see where they work and see what the environment is like. They can see the computers, they can see

the person's desk, they can see the big computer rooms, and that's very fascinating. All students love that. Plus it lets the kids see how this person interacts in a work environment with other people. They can see them working, see that they have friends, that they have colleagues, that they're a part of this working environment.

Salomé: Besides being role models, how else can, and are, African Americans in computers helping their community?

Brenda: Salomé, virtually every black person I know in computers has helped another black family get a computer!

Salomé: What about parents? What do you think African-American parents need to do to help their children think about computer education and computer careers for the future?

Brenda: I think they could do two things. First, if a child is really interested in computers, if they have a natural interest, they should support that interest as much as they can. They should get them a computer if they can.

Second, I think they should also find someone who is a computer software professional or who is in computers. That person may be able to help them get a cheaper computer or a free one. They can take them to their job and show them what they do. It's nice to have someone whom the kid can go to ask questions: "Well, what do you do with this? What about that?"

So expose the child to all the different computer stuff that's out there. You know, take them to computer museums, let them have a computer, let them use the Web, so they're familiar with the technology. Most cities have a computer club of some type, and it's usually through some nonprofit organization, through a museum, through the school, or it could be through the public library. Sometimes there are science museums in cities now.

My niece took a class last summer at the science museum. They had a special three-or-four-week course in the summer for little kids, and they made their own software programs using Hypercard, which is very easy to use. And the thing is, the kids—they're naturals. If you show them how to write a program, they do it just like 1-2-3. And then they know it's easy to make something. I think if kids can get into a class where they learn how to do computer programming, and there are a lot of them now, they're coming, they're rising up out of nowhere, everywhere, then, that goes a long way. It does three things. First, it teaches them how to do it because now in schools kids are using software programs to do their presentations and their papers. Second, it teaches them a skill that maybe they can build on later on. Third, it gives them a greater understanding that when they see a computer program, someone made it, and it's not magic.

Some kids see movies and they say, "Oh!" and they think it's magic. But if they went to a filmmaking class for kids they'd say, "Oh! There's someone behind the camera and someone made that decision to have this picture." It's the same thing with computer software.

So my niece had a spectacular time. She was really hungry for computers afterward, and I gave her my old computer when I got a new one.

Salomé: Getting back to jobs, what kind of jobs are available in the computer field, especially for those who may have other skills besides mathematics and science.

Brenda: Actually, it has nothing to do with math. The computer does math, but we don't do that stuff. We write the code. The logic of the code is what makes it go. Every computer programmer or designer or even engineer has to have two interests. One is how to think logically. The second is you need to be a detective.

There's a tremendous range of jobs in computer technology, a tremendous range. I mean, you don't have to be a programmer, you can just purely design. If a child loves computers but they have a great gift for drawing, they can be a graphic artist and a Web designer. So, all different types of jobs fit into computers now. You don't have to be just a geek (both laughing).

Brenda's Software Picks for Children

1. *Tenth Planet Explores Primary Math: Level 1 Geometry*, (grades 1-3, Mac-CD). Tenth Planet, 625 Miramontes St., Half Moon Bay, CA 94019; 1-800-546-2317; <www.tenthplanet.com>, (AA, SE).
2. *In My Own Voice - Multicultural Poets on Identity*, (grades 7-12, Mac-CD). Sunburst Communications, 101 Castleton St., Pleasantville, NY 10570; 1-800-321-7511; <www.sunburst.com>, (AA, SE).
3. *Just Grandma and Me*, (grades PreK-3, Mac-CD). Brøderbund Software, PO Box 6125, Novato, CA 94948; 1-800-521-6263; <www.broderbund.com>, (BI).
4. *WigglesWorks*, (grades PreK-3, Mac-CD). Scholastic New Media, PO Box 7502, Jefferson City, MO 48080; 1-800-777-3642; <www.scholastic.com>, (SE).
5. *Kid Pix Studio*, (grades PreK-6), Brøderbund Software, PO Box 6125, Novato, CA 94948; 1-800-521-6263; <www.broderbund.com>, (SE).

Grade-level ratings from *Educational Software Preview Guide. 1997*. Corvalis: International Society for Technology in Education.

AA = African Americans represented.

BI = Bilingual feature available.

SE = Self-expression feature available.

Culture and Computer Technology in the Classroom

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> Education is risky, for it fuels the sense of possibility. . . . A failure to equip minds with the skills for understanding and feeling and acting in the cultural world is not simply scoring a pedagogical zero. It risks creating alienation, defiance, and practical incompetence. And all of these undermine the viability of a culture. . . . Education is not simply a technical business of well-managed information processing, nor even simply a matter of applying 'learning theories' to the classroom or using the results of subject-centered 'achievement testing'. It is a complex pursuit of fitting a culture to the needs of its members and of fitting its members and their ways of knowing to the needs of the culture (Bruner, 1996, p. 43).

CHILDREN enter school enriched by their culture. Even before any formal education begins, children have come to know their world through culturally embedded events, interactions, and language. However, children are not stuck in a cement of culture either; culture is dynamic and fluid. Bruner (1996) reminds us that:

> Nothing is culture free, but neither are individuals simply mirrors of their culture. It is the interaction between . . . [people] that both gives a communal cast to individual thought and imposes a certain unpredictable richness on any culture's way of life, thought, or feeling (p. 14).

How a person thinks, feels, and acts in response to events that occur throughout a lifetime is largely driven by the culture in which he/she was raised. Culture presents an array of schema that the individual activates when deciding what to do with a new and unfamiliar situation. It is as basic as knowing what to wear to a job interview or how to ask someone out on a date. The teachers, schools, curriculum and/or instruction do not always share the cultural lens through which children participate in the lessons of school. Whether culture is shared or not, and what understandings impede learning, can be critical to the success of a child in school. Work that has been done in the area of literacy gives us much food for thought with regard to culture and schooling. See the work of Heath (1983), Delpit (1995), Fishman (1988), Moll and Gonzalez (1994), and Au (1993) for rich examples of how culture influences children's engagement in literacy.

> If computer technology is to provide constructive support for student learning, it is essential that we consider it within the context of culture.

What, then, does culture have to do with computer technology? In this issue Eleanor Linn deals directly with culture as a global construct and culture within the context of the classroom (p. 3); the interactions between students and teachers create a culture within the classroom which is embedded within the living culture which they bring to the classroom. We know that learning is both cognitive and affective and that culture plays a key role in both. It is imperative, then, that we acknowledge the role culture can play within the classroom. This article considers the implications for computer technology and culture in the classroom.

Computer technology is rapidly becoming an instrument of learning in classrooms across this nation. Some children work on project-based science with laptops in tow as they enter data on the inhabitants of a local pond; others use the Internet to follow the research of archeologists in Central America, while still others are using computers to learn to read familiar clapping songs. The shift has already occurred; future generations of children will be exiting high schools with skills and knowledge broadened by their abilities to work, communicate, and create using computer technology. Yet, as Bruner reminds us, "education is a risky business," and there is a danger that not all children will benefit from access to computer technology in the classroom. Thus, if computer technology is to provide constructive support for student learning, it is essential that we consider it within the context of culture.

There are many issues to consider when discussing culture and computer technology. This article takes up two that are critical if our goal is to level the playing field for all children: first, computers as they contribute to a shift in the culture of the classroom as we once knew it, and second, the relevance of recognizing students' individual cultural backgrounds.

Computer Technology and Instruction

What happens when computer technology is employed in classrooms? Research has demonstrated that as computers are introduced into classrooms, the potential exists for

the roles of teachers to begin to move away from traditional, teacher-centered instruction—where a lecturing style of instruction dominates—to that of a facilitator/mediator role—where the instruction is student-centered. Rather than presenting themselves as experts, the teachers in the studies Schofield (1995) describes took roles that supported a constructivist classroom that places high expectations on all children. When the teacher became the facilitator, the computer programs allowed students to become 'experts' while working at individually challenging levels and allowed for collaborative interaction with peers.

For example, Schofield (1995) reports on a study of the use of an artificially intelligent computer tutorial for geometry instruction in an urban high school of 1300 students of varied socioeconomic backgrounds. While the study was conducted in the late 1980s, its findings are still relevant today. The students were introduced to a tutoring program for their primary instruction that allowed them to work at their own pace. As a result, there were more opportunities for one-on-one interactions between students and teachers and their relationships were more collegial in nature. Furthermore, since the teachers had more individual contact with students, they considered student effort more heavily than in the past when assigning grades. Students changed too; there was a marked increase in their efforts at staying on task and completing assignments. Student attitudes were good-natured as they developed "an enhanced sense of challenge and great enjoyment for their geometry classes" (Schofield, 1995, p. 58), because the program allowed the students to work at individually challenging levels and to learn from their mistakes rather than fear them.

Schofield (1995) demonstrates that computers in the classroom can improve student learning through increased peer interaction and cooperation, but we must not assume that this is always the case. It would be an oversimplification to suggest that the mere introduction of computers into classrooms leads to positive learning experiences and teacher-student interactions. On the contrary, computer technology as an instrument of learning is complex and, as such, needs to be examined from a number of perspectives. For example, whether computer technology is used for drill and practice, simulations, tutoring, or communication is critical and can impact the ways in which teachers and students interact with one another in the classroom setting. The type of software and hardware used and by whom, the ratio of students to computers, the location of computers in the room, and the time available for computer usage all impact learning and socialization. Finally, whether computers are located in the children's regular classroom, set apart in another part of the school in a computer lab, or available in an after-school program also influence not just who gets time on the computers and how they are used, but also the connections to the content being taught in the classroom. Each of these factors, either independently or combined, has the potential to impact social and academic outcomes for our students. However, if it is the computer technology that changed the classroom dynamics in these studies, this is powerful information and should be considered very carefully in light of the plethora of software and hardware capabilities in the field today. One needs to choose carefully what programs and systems are introduced into classrooms.

Perhaps even more significant than the technology in the classroom are the human factors. While computer technology may have the potential to influence instruction in classroom culture, it is ultimately people who are the "carriers" of culture, and it is through the participants in school culture that learning takes place whether supporting students' cultural backgrounds, ignoring them, or even resisting them. Therefore, in order to assure that the technology introduced into instructional settings promotes rather than hinders learning, we must also consider cultural variations among students.

Computers and Cultural Learning Styles

Each child entering school comes with already formed ideas about how the world works and how to interact with others in that world. This prior knowledge is culturally bounded in ways that influence factors critical to school success. Research described below provides insights into how critical it is to consider the culture of the learner.

Delpit (1995) reports on a survey administered to middle school children in Alaska, where they were asked to rank their preferences for learning from a list that included computer usage. While the study was small, its results give pause for thought. The African-American and Native-Alaskan children in her study placed importance on their relationships with their teachers. They ranked learning from teachers they liked above learning from books, computers, teachers they did not like, and even their friends, whereas the white children in the study described preferences for learning from computers and books. Based on this survey, Delpit (1995) warns that if we "shift completely to computer-based instruction, we risk failure in our educational reforms by ignoring the significance of human connectedness in many communities of color" (p. 95). Programs

such as Schofield (1995) describes, in which computer technology facilitates more teacher-student interactions, would probably lend themselves well to instructing the children Delpit surveyed.

In another study that focused on learning styles, Fleer (1989) examined the use of computer technology by Aboriginal children in Australia, with particular attention to the already established body of literature on Aboriginal cognitive strengths. Their learning styles favored instruction involving real-life performance rather than simulations or artificial settings, people-oriented tasks and mastery of context-specific skills rather than abstract, generalizable skills, and trial and error tasks and observation and imitation rather than oral or written instruction (Fleer, 1989, p. 613). The implications for the ways in which computer technology needs to be introduced to these children so that it is compatible with their native culture and has, therefore, the potential to support their ways of knowing the world seem obvious. Instruction needs to be sensitive to preferred learning styles, while allowing for the gradual introduction and scaffolding of other modes. Fleer argues, as does Delpit, that this is not about denying children access to mainstream ideology or technology, but supporting students in their own styles of learning while they are gaining new knowledge and skills. Fleer reminds us that Aboriginal communities are no different from others in their expectations for their children. They, too, want their children to have the skills which will ensure that they can succeed in the wider Australian society—as "doctors, engineers, lawyers, teachers, and other highly educated professionals" (1989, p. 614).

> If we shift completely to computer-based instruction, we risk failure in our educational reforms by ignoring the significance of human connectedness in many communities of color.

In studies conducted in primary classrooms in an urban magnet school, Au and Kawakami (1991) concluded that "culturally responsive education means incorporating some features of the child's natal culture into the curriculum, teaching methods, and instructional materials" (p. 164). They describe classrooms where learning preferences were supported by allowing "students whose cultures value cooperation and interdependence such as Mexican-Americans and African-Americans. . . [to] work and share with others. . . . [and for] those whose cultures value independence and self-reliance such as the white culture. . . [to] work alone" (1991, p. 171). Au and Kawakami (1991) report that when instruction in these classrooms was culturally congruent and respectful of the differences among the children, and when varied features of culture were incorporated into instruction, the learning potential for all the children was optimized.

Culture and Software Content

In the studies of the Australian Aboriginal children, Fleer (1989) demonstrates that instruction is effective when the content of the computer software used is culturally sensitive, not only to learning styles but to cultural values as well. She notes that the software should reflect "appropriate aboriginal knowledge, skills, and cultural values" in order to allow children opportunities that will reinforce a positive sense of self-esteem and promote a learning environment where students will be able to succeed.

The important reminder from Fleer's work is that not all students learn in the same manner, and this is largely influenced by culture. While learning styles may be a key factor in how children respond to various modes of instruction, another important aspect is the cultural sensitivity of program content. What is appropriate to discuss in one culture may not be appropriate in another. It is, therefore, imperative that the local community be involved in the development and/or selection of software, particularly software intended for instruction of children whose dominant culture is not white, middle-class mainstream culture. Thus, for the Aboriginal community in Fleer's study, the software that was culturally sensitive was most effective for instruction.

Fleer describes *Tjina* (meaning "feet," "tracks," or "movement") as an effective primary program in that it was designed so that the suggested activities took place away from the computer and were integrated across the curriculum. The software used Aboriginal characters in the graphics and text, relied on stories familiar to the children, and used graphics that supported the Aboriginal strength of learning visually. For example, the stories contained themes such as hunting and included characters that were from extended rather than nuclear families. The software was also designed to be the catalyst for lessons that allowed for interaction among students that relied on group work and included self selection of difficulty levels, open-ended design, and easily modifiable text to cater to the range of literacy abilities

within the classes (Fleer, 1989, p. 616). It is important to note that the software developers involved the elders of the community in evaluating the software for cultural sensitivity before it was used with the children.

Another example of culturally sensitive computer-program content comes from work done with the Saami of Norway. While the Saami may be unknown to most of us in the United States, their life's work is not; the Saami livelihood depends upon reindeer breeding. The government of Norway, concerned for its minority populations, has placed a great deal of importance on the cultural relevance of instructional materials and software development. Thus, the Norwegian government set out to develop software that would take into consideration Saami linguistic and cultural diversity in order to provide equal educational opportunities. The resulting software program employed a reindeer breeding simulation that created a culturally appropriate scaffold for instruction beyond the actual breeding situation presented in the instructional materials. Norway has established goals for technology that deliberately make the technology accessible to all its citizens—regardless of how small a particular cultural or linguistic group may be (Hernes, 1991).

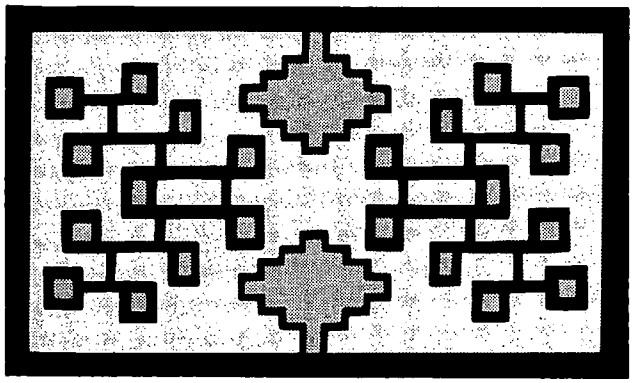
Cultural Heritage and Computers

The relationship between language and culture is deep and pervasive. Maintenance of one's culture goes hand in hand with maintenance of one's language. In an effort to provide support for linguistic minority students, Sayers (1991) describes a program that has been developed to promote "cross border" exchanges between students from the same cultural and linguistic background. The program, *De Orilla a Orilla* ("from shore to shore"), supports communication between minority-language, immigrant students in the United States and bilingual and Canadian-heritage language students from the mother culture. These communications are class-to-class projects where teachers of these populations of students are matched by interests and grade levels. These matched classes work together on projects such as shared student newsletters, comparative investigations, science projects, or the development of oral histories. *De Orilla a Orilla* projects are multilingual, including French, Haitian Creole, English, Japanese, Portuguese, and Spanish, and they span the globe, including schools in Puerto Rico, Canada, Costa Rica, France, Japan, Mexico, and the United States. The URL for *De Orilla a Orilla* is <orillas-web.upr.clu.edu>.

> Like any human artifact, computers are an expression of the people and culture that created them.

Knowledge of the stories, language, and ways of one's ancestors is important to all students. Awareness of one's cultural heritage builds self-esteem and pride. In addition, when one's heritage is accurately represented in the content of the school curriculum, the benefits to students are immeasurable. Yet for many children of underrepresented cultural groups in mainstream society, the stories are often missing or inaccurate. It is essential that we pay attention to the multicultural nature of our classrooms. In some cases it is a matter of choosing material that is representative of our multicultural society and information that is accurate. However, for many groups the information is at risk of being lost forever to future generations because it is not being passed on.

This is an area where technology can contribute not only to direct classroom instruction but also to the content available for that instruction. An example of computer technology that has responded to the need for an inclusive body of knowledge is the work that is currently being done by Native American tribes. In addition to using computer technology for disseminating information on local events within tribal communities, tribal members are using computer technology to record and teach native languages, tribal history, and traditional culture and knowledge. For example, on the Hualapai Reservation in Peach Springs, Arizona, and on the Pine Ridge Reservation in Kyle, South Dakota, Hypercard programs have been developed that focus on pronunciation to enhance learning of native languages. At the Oglala Lakota College on Pine Ridge, faculty and students are working together to document on CD-ROM their community's history, including events such as the Bigfoot Massacre in 1890 and the Wounded Knee Uprising in 1973. The Navajo at Window Rock, Arizona, are recording their traditional world view on CD-ROM. All of these applications of culture to technology will allow for Native Americans to maintain their cultural heritage. Furthermore, these CDs will provide important learning materials not only for children in reservation schools, but in all schools, and provide opportunities for expanding our understandings of one another and our nation's development from a perspective not often found in text-



Navajo Rug, early 20th century

books. Additionally, the students working on the programs are learning to use computer technology for a meaningful purpose.

Conclusion

While it is important to take culture into consideration when introducing computer technology into the instructional environment, culture alone cannot bring equity to technology in the classroom. It is only when all conditions for optimal learning are in place, as is discussed in this and other articles in this newsletter, that all children will have equal opportunities to learn. While "education may be risky," the potential for fueling "the sense of possibility" is real, and we must reach for it. Thus, an awareness of cultural difference is not enough; we must be knowledgeable and sensitive to difference while at the same time embracing and integrating it into our instruction. However, it is important to note that cultural sensitivity is essential, but not sufficient. Recognition of cultural differences will help inform the educator of critical aspects of learning such as learning styles, linguistic diversity, traditional customs, and cultural heritage, but knowing must lead to acting.

Based on her studies of computer technology in classrooms, Chisholm (1995-96, Winter) sounds an important warning, which perhaps should be contained on the labeling that accompanies computer technology intended for classroom use. She states that while

> computers and software convey a sense of objectivity and neutrality, they essentially are not culture-free. Like any human artifact, computers are an expression of the people and culture that created them. Likewise computer software incorporates the programmer's cultural assumptions, heuristics, and epistemology. Even seemingly impartial applications such as databases and word processing programs demonstrate a cultural preference for analytic, linear thinking, compartmentalization of information, and culture-specific logic, rules, and organizations (p. 163).

The implications for children who are learning content and skills for the first time or who are using these skills and content to further engage their minds for academic achievement are enormous. Computer technology's potential to contribute in positive ways to engaging students in learning that promotes academic achievement cannot be considered to be culture-free, nor teacher-proof. Rather, its potential will be realized only when teachers who hold high expectations for all learners in their classrooms consider the cultural ramifications of computer technology when it is used as an instructional tool, a source for content, or a means to engage children in higher-order thinking tasks. In short, culture matters.

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Gender Equity and Computer Technology

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Mike Mulligan had a steam shovel,
a beautiful red steam shovel.
Her name was Mary Anne.
Mike Mulligan was very proud of Mary Anne.
He always said that she could dig as
much in a day as a hundred men
could dig in a week ...

THE image of the good man made ever more powerful by the efforts of his strong, faithful, and female machine is imbued with heavy significance in our culture. I love the simple beauty of Virginia Lee Burton's iconic story *Mike Mulligan and His Steam Shovel* (1939) and dearly remember the faces of children mesmerized by her tale. Like the folk hero Paul Bunyon with his Blue Ox Babe, Mike Mulligan can do anything because of the hidden power of Mary Anne. As a young female child, I identified not with Mike, the human male, but with Mary Anne, the female machine. I strove not to be powerful and independent like Mike was, but dependable, hardworking and lovable, like Mary Anne.

The image of the male machine in literature is not as reliable. It often has a will of its own, which it exerts at just the wrong time. Dr. Frankenstein's monster, as described by Mary Shelley, is strikingly similar to the Yiddish story of the Golem of the Rabbi of Prague, and to HAL the computer in Kubrick's film "2001," both of which make threatening demands on their male inventors and operators. These stories tell us that managing a complex machine can be risky, even fatal. To some children, many of them male, the dangerous machine provides a thrill. To others, like me, it foretold danger. Like Strega Nona's young male assistant, I thought it best not to touch the magic cooking pot until I really knew what I was doing.

> The military technologists who developed the first computers bequeathed us a vocabulary about computers that is violent, abusive, and sexist.

As a computer user, I became more comfortable when I realized that the computer could be my faithful Mary Anne and not necessarily an uncontrollable Golem. I realized that either taming the computer or loving the beast is easier for some people than for others, in large part because of the gender stereotypes of our culture. In this article I briefly describe research on gender and attitudes toward technology. I then retell the history of computer technology, noting its influence on the language we use, the design of software, and computer use in school. This history shows how much gender bias pervades computer technology and makes it less friendly for girls. Computer culture also reinforces many stereotypes that are harmful to both boys and girls, but gender bias is not inevitable. We can redress it successfully and even use computer technology to overcome some of the gender-based limitations that we place on children.

Attitudes toward Technology

"I think the computer hates me," said a sixth grade girl in a computer class, when she encountered mechanical difficulties while using the Internet (Wilcox, 1996). For many of us, in some imaginary way, the machine is almost alive. It talks, it evokes our feelings, and we may find ourselves, even against our better judgment, relating to it as though it were another living thing, ascribing to it a name and a personality.

Faced with the frustration of controlling a machine that we know little about, we tend to react in gender related ways. Men may become more aggressive, women more passive. If we have little technical information about what to do and little awareness of the source of our feelings, our coping strategies may develop into exaggerated behaviors, perseveration (excessive repetition) in boys and computer avoidance in girls.

Dorothy Wilcox connects these gender related coping strategies to Carol Dweck's well-known research on attribution of success and failure. When boys fail at a task, they tend to explain it as a lack of effort and thus often try harder. When girls fail at a task, they tend to see it as a lack of their own innate ability and thus are more likely to give up. Trouble-shooting skills and emotional support helped Wilcox's sixth-grade girls overcome what she called their computer docility. Learning how to control the computer took away some girls' fears of being rejected by a machine. This fear of rejection is not irrational. It may well come from a history of being rejected personally and culturally as a female in a male dominated society

When boys perseverate in learning to use computers, some researchers see this behavior as positive, others as negative. Spending long hours with the computer may reflect a willingness to invest the necessary time in learning to use it successfully (Sanders and Stone, 1986; Albert, 1997). Without long hours of passionate initiation, there is little chance for anyone to develop much competence at the computer, according to some people. From this point of view, extended computer time at home, computer clubs, and camps are indispensable additions to everyone's education. The equity issue becomes how to give girls as well as boys, and poor children as well as affluent children, these expensive, time-consuming opportunities which most schools do not provide.

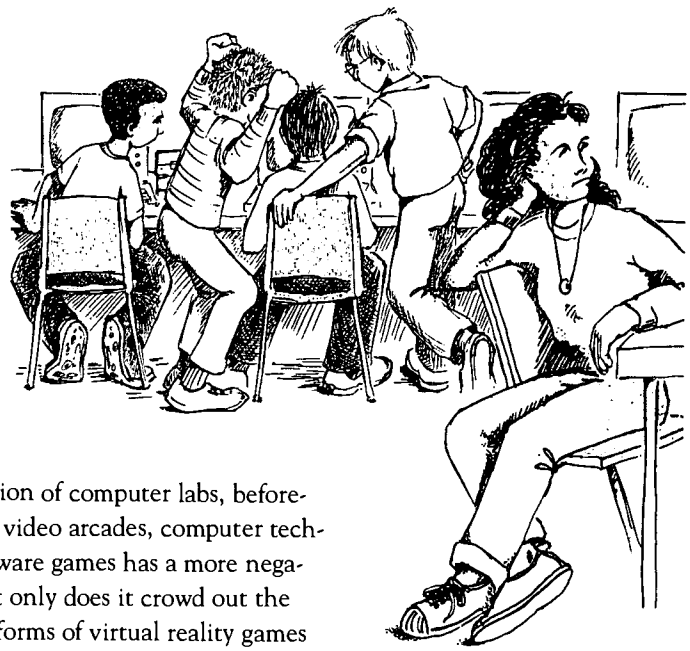

Illustration by Joan Auclair

To others, boys' near monopolization of computer labs, before-and-after-school programs, video arcades, computer technology magazines, and software games has a more negative effect on the boys. Not only does it crowd out the girls, they claim, but some forms of virtual reality games actually increase the users' physiological arousal and aggressive thoughts (Greenfield, 1994; Calvert and Tan, 1994). Computer use of this type can heighten the distance between thoughts and feelings, people and things (Turkle, 1995). Such computer use may be counterproductive to society. The equity recommendations here are to limit the use of aggressive games, slow down the pace of software, monitor children's use of computer time, and be aware of potential problems of computer addiction.

History

The history of computer technology brings us little help in advancing gender equity. Although Ada Lovelace (1815-1852) is generally credited with having first conceived the idea of a machine that could calculate (Stein 1985), most of the technological developments that led to the modern-day computer came from the military (Edwards, 1990). Not only did the thinking involved in programming develop as a highly structured, exacting, and linear process, but the computer scientists working on these machines, almost all of them white men, were seen as exemplifying these very same qualities of "hard mastery . . . the rigidities of pure logic and the impersonality of corporations and governments" (p.105). Spontaneity, warmheartedness, compassion, and aesthetic pleasure were all seen as aspects of softness and emotionality, denigrated female categories in direct opposition to the world of computers. It should be no surprise that such extreme polarization had little appeal for women. People using computers have both thoughts and feelings, reason and compassion, and they need to be recognized for all aspects of themselves.

Today's electronic communication and easy-to-use operating systems have changed this gendered view of the computer, but they have not transformed our gender stereotypes. The Internet, once a tool for mostly-male, high-level scientific communication, has become a way for families to keep in touch. It now provides recipes and clothing catalogues, as well as military plans and scientific research. But the evolution of the computer, from performing mostly male-identified tasks to performing female-identified and non-gender specific tasks, does not mean that we have overcome gender bias and sex stereotyping. We have simply expanded the range of tasks that the computer performs.

Biased Language

The military technologists who developed the first computers bequeathed us a vocabulary about computers that is violent, abusive, and sexist. For me, it creates a daily irritant in my use of the equipment. When I want to discontinue an instruction, I must abort a command. This terminology trivializes for me my most powerful memories of life, death, gender roles, and sexuality. It forces me to remember major life crises when all I want to do is correct a keystroke error. If I am curious about how many visitors have come to our program's website, I am given the number of hits and am repulsed to see myself as a voracious cannibal, or spiderwoman, catching and consuming my most casual guests.

Some language issues are not directly related

to sex, but they offend the cultural style of a white woman like me. When I inadvertently leave out one keystroke in a friend's e-mail address, I am stricken with the news that the address, in my mind the addressee, has "permanent fatal errors." I feel an immediate need to telephone about her health. When I sign on to the university's server, I am forced to relive memories of the Vietnam War, as my request may be answered by servers named choplifter and battlezone. These are small irritants, but they remind me that the creators of this cyberspace are not like me, and that perhaps I don't belong.

Sexist Software

A great deal has been written about computer games and websites that are blatantly offensive to women. Lone male warriors battle to save mindless and unknowable female sex objects, and the photos on the outside of software packages remind me of 1950s auto-shop calendars. Useless women pose in unwearable clothing or in nothing at all. Developers claim their market is almost exclusively men and boys, so they produce images that appeal to this market segment. Software 'for girls' reinforces the sexist message further by falsely claiming that Barbie, fashion, and cosmetics provide equity balance. They do not. They perpetuate sexism and serve only to enrich the companies that produce them.

> We have the opportunity to make computer use accessible and meaningful for everyone.

Anthropologist Christine Ward Gailey has analyzed the class and gender messages in popular home videos (Gailey, 1993). Even in games that are considered sexually understated and appropriate for both genders, in keeping with the preferences of parents of children in the preadolescent market, there is intense gender antagonism, a preponderance of helpless princesses, and the frequent appearance of dangerous 'jungle-women' who must be killed. Nominally good female characters are more often caregivers than decision makers, and they provide male characters with 'quickie', unrealistic resuscitation. These are hardly the roles that we want young people of either gender to emulate. They need to learn that cooperation and caring are built over time through empathy and courage.

In schools, we may feel that we are free of the worst of commercial sex bias. We may decide to review the software we purchase or bring to school, screen out pornography on the Internet, and ban action games altogether. This step may seem obvious, but a recent highly regarded ethnography of fourth grade students creating their own computer games (Kafai, 1995) failed to notice the blatant sexism in the children's own game narratives. As educators, we need to inform students and parents of the harmful gender messages contained in fluffware (stereotyped software for girls) and fluffsites (websites that reinforce stereotypes of girls and female behavior). Marta Larson's checklist in this issue (p. 20), the interview with Brenda Matthis (p. 6), and Bill Bigelow's review of the Oregon Trail (p. 22) should help educators begin to look at the hidden equity issues in software more critically.

Technology Adoption in School

In most schools, the history of the adoption of computers shows gender bias from the very beginning. The first computers were very expensive, and they were introduced only in research and administrative offices. They were closely overseen by high-level male employees, with the tedious data entry work done by far-lower-paid female assistants. Most schools' first educational computers were used by predominantly white male students in highly tracked, advanced mathematics classes, and they were located where other staff and students could not use them. Young women, if they used computers at all, were introduced to them in wordprocessing classes where they were tied to secretarial applications.

Today, with computers in nearly every classroom, computer labs available to many students, and applications in many content areas, we have the opportunity to make computer use accessible and meaningful for everyone. Our challenge is to find the ways to make this statement a reality.

Using Technology to Expand Gender Roles

Perhaps the most hopeful area of gender equity and computer technology is the application of computers to expand children's gender roles. Kaveri Subrahmanyam and Patricia Greenfield (1994) found that fifth grade girls improved their spatial relations skills by playing a game called Marble Madness. Lynn Okagaki and Peter Frensch (1994) saw spatial relations skills improve with older girls who played the game Tetris. Since spatial relations is a skill with documented gender differences that favor boys, this research may be encouraging. Dorothy Wilcox (1996) found the computer was an excellent way to teach persistence, another gender related skill, to a group of sixth-grade girls. Sherry Turkle (1995) hypothesizes that boys may learn greater empathy and caring skills through MUDS (multi-user domains) on the Internet.

In another promising piece of research, Hsi and Hoadley (1997) found that electronic participation made students' participation more gender equitable, counteracting the usual male domination of classroom participation. Their research involved eighth-grade students in a science unit on thermodynamics. A time-limited sign-up system ensured that girls had equal access to the computers, and students were assigned to gender-balanced groups of fifteen. On-line discussion groups of 7 had too few responses to provoke thoughtfulness, while groups of 30 had too many responses for students to read productively. Students were provided with an anonymous response option as well as one in which their name and photograph appeared. The girls liked the anonymous option far better than the photo option and used it more frequently. The boys preferred the photo option. The students were asked thought-provoking and controversial questions on a computer kiosk and were required to respond at least twice. The questions were posted for about four weeks at a time.

With these pieces in place, student conversation rose from 15 percent (predominantly male) participation in face-to-face classroom conversation, to 78 percent (gender balanced) using the computers. Obviously, this intervention helped the quiet boys as well as the girls. Girls reported being particularly enthusiastic about the opportunity to respond without immediately hearing negative comments from their male classmates, having the time to think before responding, and having the opportunity to respond anonymously. The boys who had participated most frequently in classroom conversations did not report any difference in their frequency of response or in how much they liked the class. Not surprisingly, all students' comprehension of the physics material was enhanced by their increased participation. Although critics may claim that this project did not transform gender relations in the classroom, it does seem to have circumvented the gender hierarchy in such a way that a sizeable number of girls felt safer to pursue their learning.

Rosemary Sutton's 1991 meta-analysis of computer access and attitudes shows that girls' favorable attitudes toward computers are, on the whole, only slightly lower than boys and their access is only slightly less. Modest differences can surely change over time. School and teacher attitudes, programs, and resources appear to make a much larger difference in children's attitude than children's gender. That means, writes Sutton, that we can shape the environment differently to encourage children of both genders to be more expert in their computer use.

We have a long way to go before equal numbers of girls and boys will enjoy working with a dependable Mary Anne or a dangerous Golem. It must be our long-term goal. On the way there, however, I hope that new applications, new awareness of our biased heritage, and thoughtful and equity-minded implementation plans will help prepare us for the opportunities that we must give to all students. If we want the computer to transform education into better thinking skills and opportunities for all students, we all need to work hard and make a true commitment to equity to make it happen.

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Parents, Computers and Telecommunications

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Parents watching their first and fourth graders "playing store" expected to see their children punching the cost of their purchases on an imaginary cash register as they did when they were children. Instead they experienced culture shock when the children pretended to scan each item with an imaginary bar code scanner!

COMPUTER technology and telecommunications are touching and changing the life of every family, no matter what the gender, nation of origin, or ethnic background. It may seem that parents have no control over what is happening to their children. But wait! Parents do have control. In fact, the choices parents make not only influence how technology affects their families, but they also influence how technology will develop in the future.

Parents can manage the influence of computers and telecommunications on their families. Parents can decide the extent to which their children will have access to computers and telecommunications. Parents can control the extent to which the materials brought into their home through computers and telecommunications reinforce and support their values, beliefs and culture. It all starts with parents doing what they do best in their role and responsibility as parents: leading and providing for their children, providing a safe and secure place for their children to grow and explore, and passing on the positive aspects of their family culture.

Parents Can Lead the Way

One of our first responsibilities as leaders of our families is to learn as much as we can about computers and telecommunications (Pearson, 1996). That means learning the vocabulary people use when they talk about these tools, the advantages and disadvantages of this technology, and the problems and promises this technology presents to families and individual users. It may also mean learning the responsibilities regarding computers and telecommunications that local, state, and national government agencies and private commercial organizations have regarding the impact of computer and telecommunications technology on our schools, families, and other aspects of our lives.

Parents who are interested in gaining and using knowledge about computers and telecommunications to benefit their child's education can take several steps at home and in their community to inform themselves If you are a parent who wants to become more aware of computer technology you can . . .

Expand on what you already know by talking with friends, neighbors and co-workers who use computers and telecommunications and who are willing to share what they know.

Observe how computers and telecommunications are being used wherever you go—for instance, at stores, gas stations, government offices, and so on.

Visit nearby computer stores and talk to knowledgeable sales clerks who are willing to share their knowledge, provide you with reading material, and instruct you in using demonstration models (Pearson, 1996).

Keep current on this ever changing field through books, magazines, or newspaper articles, through television and radio, or through information available through the Internet.

Ask your city council member, state representative, or national congressperson for written information about the policies, procedures and proposed regulations related to the use of computers and telecommunications at public schools and public libraries.

Share your knowledge and expertise about computers and telecommunications with other families. Parents who feel they are keeping current about computers and telecommunications in general still may not be involved in their children's experiences with computers and telecommunications at school. This is an ever changing experience that requires periodic checking and rechecking.

If you are a parent who wants to have more influence on the effect of computers and telecommunications at your child's school then you may want to . . .

Volunteer to teach what you know in your child's class or to share what you know about computers and telecommunications with a group of parents at your child's school.

Volunteer to serve on committees making decisions about the impact of computers and telecommunications on the schools or libraries where you live.

If you are a parent who wants to learn more about what the schools are doing about computers and telecommunications, you may want to . . .

Ask at the school board or principal's office if there is a written copy of the plan for the use of computers and telecommunications in the school district. Some state departments of education require a long-range plan of districts to whom they have awarded telecommunications grants.

Ask the school principal or your child's teacher how computers and telecommunications are being used in your child's school.

Specific questions you may want to ask are . . .

How does my child's teacher use computers and telecommunications to teach my child?

How often does the teacher use these tools in teaching the class?

What is my child supposed to learn about computers and telecommunications each school year?

What is my child learning about how computers and telecommunications work, how to program computers, and how to create sites on the Internet?

What kind of computers are students learning to use?

How many children are there per computer?

How often does my child use the computer at school?

How well is my child doing in using computers and telecommunications?

What is my child's attitude toward computers and telecommunications?

What kind of program application software do the students use?

Who reviews the software applications to see that they are free of biases?

Are children at a disadvantage in their class work or homework if they do not have the use of a computer or telecommunications outside of school time?

What is being done to make sure no students are at a disadvantage because of their gender, language background, or economic level when it comes to computers and telecommunications?

Informed and involved parents are more aware of how computers and telecommunications are affecting their families, and they are better prepared to affect the future of computer technology on behalf of their families in general and on behalf of their school aged children in specific.

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The Checklist

Guidelines for Selecting Equitable Electronic Materials

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SENSATIONAL stories occasionally appear in the popular media about computer games that either contain excessive violence or are demeaning to a race, ethnic group, or gender. The objectionable material described in these stories is often so blatant that it is easy for even the most uninformed person to spot.

However, games and other electronic materials can contain much more subtle biases that can elude the notice of the most well intentioned educator. This checklist identifies some of those subtle biases. Although not all questions apply to every piece of software, think carefully before you decide that a question does not apply. More information on techniques for screening print and audiovisual material for bias is available in the references cited at the end of the article.

Distinct disproportionalities exist in computer access and use by English language proficiency, ethnicity, race, and gender, as Ted Wilson points out elsewhere in this issue (p. 26). Lack of screening for bias in electronic materials contributes to those disproportionalities.

'Group(s)', as used in this checklist, is meant to designate the *language proficiency, ethnicity, race, gender and disability groups* to be considered in screening for bias and inequities in educational materials. It is used merely as a space-saving device, and no disrespect to any individual group is intended.

Finally, the term "electronic materials" refers to computer software, CD-ROMs, and websites that the school either has in its possession or makes available to the students through the Internet.

Using the Checklist

If your district has a systematic written process for evaluating electronic materials, consult it and check every question to which you can confidently answer 'yes.' "Scoring the Checklist" on page 25 tells you how you fared.

If your district does not have a systematic written process for evaluating electronic materials, we would advise you to prepare one and begin using it. Refer to the points in this checklist and throughout this issue of *Equity Coalition* for information on what should be included, and read the feedback in "Scoring the Checklist" on page 25 for specific suggestions on how to get started.

Human Roles

____ Are all groups involved in a variety of living situations, life-styles, levels of affluence, and social conditions accurately presented in a bias-free way?

____ Is there a variety of groups portrayed in a variety of occupational tasks and careers?

____ Are all groups involved in ordinary tasks such as household, school, parenting, community, recreational and leisure activities?

____ Are all groups developing independent lives, independently meeting challenges, and finding their own solutions?

____ Are all groups portrayed with a range of human responses, leaders and followers, adventurous and aggressive as well as sensitive, gentle as well as strong, physically active as well as inactive?

Illustrations

____ Are they true to the people depicted, not caricatures, stereotypes or tokens?

____ Is a variety of groups portrayed in a variety of situations, both independently and interacting with each other?

____ Are the illustrators/photographers members of group(s) portrayed, or do they have substantial experience with photographing/illustrating the group(s)?

____ Does the packaging and/or advertising show a diversity of groups rather than one group to the exclusion of others?

Language

____ Is the language the real daily language of the people represented?

____ Is the language free of biased terminology, avoiding use of the universal masculine pronoun and racially/ethnically demeaning terms?

____ Does the material acknowledge that learners may have a variety of home languages and take that into account?

Audio

____ Does audio material include narrators from a range of group voices?

____ Does the sound track include a variety of styles of music/sounds?

Content

____ Are all groups substantially represented, not just as tokens?

____ Is representation of groups historically and experientially accurate?

____ Is the approach multicultural and nonsexist as opposed to Eurocentric and male-oriented?

____ Does the content avoid assuming that all people are operating from the same group, perspective and/or values?

____ Is the material realistic to the situation it is portraying, and does it avoid glossing over controversial topics or issues?

____ Are issues relating to groups routinely included within the content as opposed to being separated out as 'special concerns'?

____ Are contributions and participation of all groups a part of the content?

____ Is a wide variety of groups available for students to identify with?

____ Is it clear that decisions made in simulations can have positive effects on some groups while having negative effects on other groups, and are implications of actions and/or decisions for all groups made clear to the user?

____ Does the material avoid focusing on only one ideological orientation?

____ Do users learn transferable computer skills and avoid repetitive drill and practice?

____ Does the material fit into the curriculum objectives for the subject area?

Environmental Issues

____ Does the material accommodate students working alone and accommodate multiple roles if students work in groups?

____ Is the material designed effectively and explained thoroughly enough so that new users will be engaged quickly?

Focus

____ Does the theme avoid identification with a single group?

____ Does the material avoid making eye-hand coordination, competitiveness, racing against the clock, violence, warfare, target practice, or fighting the only aspect?

____ Is problem solving a major aspect?

____ Does the material attract the interest of all groups, not just the members of one group?

____ Does the material weave together more than one learning style, e.g., holistic thinking and linear thinking, right brain and left brain?

Whole Program Issues

Considering the electronic materials available to your students as a total collection, answer the following questions:

____ Does your district policy for the selection and use of electronic materials include a specific selection process, issues related to students bringing in materials from home, Internet access and safety issues, parental input or knowledge of selection process, and a procedure for reporting offensive or inequitable material?

____ Are you certain that your district policy for the selection and use of electronic materials is used every time electronic materials are obtained or made available to students?

____ Is there a wide range of materials available, including both competitive and problem solving types of programs?

____ If you use reviews in magazines or other media to help you select electronic materials, have you verified whether these reviews check for and/or address equity issues, and have you taken steps to compensate for those that don't?

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(scoring on page 25)

On the Road to Cultural Bias:

A Critique of "The Oregon Trail" CD-ROM

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IN *Oregon Trail (OT)*, students become members of families and wagon trains crossing the Plains in the 1840s or 1850s on the way to Oregon Territory. A player's objective, according to the game guidebook, is to safely reach Oregon Territory with one's family, thereby "increasing one's options for economic success."

I can see its attraction to teachers. One can't play the game without learning a lot about the geography from Missouri to Oregon. Reading the trail guide as one plays teaches much about the ailments confronted on the Oregon Trail, and some of the treatments. Students can learn a tremendous amount about the details of life for the trekkers to Oregon. And the game has a certain multicultural and gender-fair veneer that, however limited, contrasts favorably with the white-male dominated texts of yesteryear. But as much as the game teaches, it *mis*-teaches more. In fundamental respects, OT is sexist, racist, culturally insensitive, and contemptuous of the earth. It imparts bad values and wrong history.

OT maneuvers students into thinking and acting as if they were all males—**white** males.

They Look like Women, But . . .

To its credit, OT includes large numbers of women. Although I didn't count, women appear to make up roughly half the people students encounter as they play. But this surface equity is misleading. Women may be present, but gender is not acknowledged as an issue in OT. In the opening sequences, the game requires students to select a profession, special skills they possess, the kind of wagon to take, the city they'll depart from, etc. Class is recognized as an issue — but not gender or race — a player cannot choose these.

Without acknowledging it, OT maneuvers students into thinking and acting as if they were all males — and, as we'll see, *white* males. The game highlights a male life-style and poses problems that historically fell within the male domain. However, women and men experienced the Trail very differently. It's clear from reading women's diaries of the period that women played little or no role in deciding whether to embark on the trip, where to camp, which routes to take and the like. In real life, women's decisions revolved around how to maintain a semblance of community under great stress, how "to preserve the home in transit."

These were real life decisions, but, with the exception of treating illness, they're missing from OT. Students are rarely required to think about the intricacies of preserving "the home in transit" for 2000 miles. An OT information box on the screen informs a player when "morale" is high or low, but other than making better male-oriented decisions, what's a player to do? OT offers no opportunities to encounter the choices of the Trail as women of the time would have encountered them, and to make decisions that might enhance community, and thus "morale."

Similarly, OT fails to represent the *texture* of community life on the Trail. Students confront a seemingly endless stream of problems posed by OT programmers, but rarely encounter the details of life, especially those of women's lives. The male orientation of OT is brought into sharp relief in the game's handling of Independence Day commemoration. Students as pioneers are asked if they wish to "Celebrate the Fourth!" Click on this option, and one hears loud "Yahoos" and guns firing. Compare this to the communal preparations described in Enoch Conyers' 1852 diary (but not in OT) [where a group of young women work together to make a flag out of clothing scraps].

The contrast between the "Yahoos" and gunfire of OT and the collective female exhilaration described in the diary excerpt is striking. This comparison alerted me to something so obvious that it took me awhile to recognize. In OT, people don't talk to *each other*, they all talk to you, the player. Everyone in the OT-constructed world aims her or his conversation at you — underscoring the simulation's individualistic ideology

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that all the world exists for *you*, controller of the mouse. An *OT* more alert to feminist insights and women's experiences would highlight relationships between people, would focus on how the experience affects our feelings about each other, would feature how women worked with one another to survive and weave community, as women's diary entries clearly reveal.

As I indicated, large numbers of women appear throughout the *OT* simulation, and they often give good advice, perhaps better advice than the men we encounter. But *OT's* abundance of women, and its apparent effort to be gender-fair, makes an essential problem: the choice-structure of the simulation privileges men's experience and virtually erases women's experience.

African Americans as Tokens

From the game's beginning, African Americans dot the *OT* landscape. However, by and large they are no more than black-colored white people. Even though Missouri was a slave state throughout the entire *OT* period, I never encountered the term "slavery" while playing the game. I found race explicitly acknowledged in only one exchange, when I "talked" to an African-American woman along the trail. *OT's* treatment of African Americans reflects a very superficial multiculturalism. Black people are present, but their lives aren't. Attending to matters of race requires more than including lots of black faces, or having little girls "talk Black."

Even though one's life prospects and world view in the 1840s and 1850s — as today — were dramatically shaped by one's race, this factor is invisible in *OT*. Players know their occupations but not their racial identities, even though this knowledge is vital to decisions participants would make before leaving on the journey as well as along the way. Once students-as-pioneers arrive in Oregon, most will live happily ever after — never considering the impact that race would have on life conditions.

Just Passing Through?

OT programmers are careful not to portray Indians as the "enemy" of westward trekkers. However, the simulation's superficial sympathy for Native groups masks a profound insensitivity to Indian cultures and to the earth that sustained these cultures. The simulation guidebook lists numerous Indian nations by name — and respectfully *calls* them nations. The *OT* guidebook explains that emigrants' fear of Indians is "greatly exaggerated."

The ideology embedded in *OT* is selfish and goal-driven: Care about indigenous people insofar as you need to avoid "misunderstanding" and incurring the wrath of potentially hostile natives. *OT* promotes an anthropocentric earth-as-natural resource outlook. Nature is a *thing* to be consumed or overcome as people traverse the country in search of success in a faraway land. The simulation's structure coerces children into identifying with white settlers and dismissing nonwhite others. It contributes to the broader curricular racialization of identity students absorb — learning who constitutes the normalized "we" and who is excluded.

OT players need not take into account the lives of others unless it's necessary to do so in order to accomplish their personal objectives. Thus the cultures of Plains Indians are backgrounded.

The consequence of the Oregon Trail for the Plains Indians, the Indians of the Northwest, and for the earth were devastating. In fairness, as they play *OT*, students may hear some of the details of this upheaval.

However, wrapped in their cocoons of self-interest, *OT* players push on, oblivious to the mayhem and misery they cause in their westward drive. This is

Denver Public Library, Western History Division

surely an unintended, and yet intrinsic, part of the game's message: Pursue your goal as an autonomous individual, ignore the social and ecological consequences; "look out for number one."

No Violence Here

OT never suggests to its simulated pioneers that they should seek permission from Indian nations to travel through their territory. And from this key omission flow other omissions. The simulation doesn't inform players that because of the disruptions wrought by the daily intrusions of the westward migration, Plains Indians regularly demanded tribute from the trekkers. They resented this Indian-imposed taxation and their resentment frequently turned to hostility and violence, especially in the later years of the Trail.

Despite the increasing violence along the Oregon Trail, one choice *OT* programmers don't offer students-as-trekkers is the choice to harm Indians. Doubtless MECC, producer of *OT*, is not anxious to promote racism toward Native peoples. However, because simulation players can't hurt or even speak ill of Indians, the game fails to alert students that white hostility was one feature of the westward migration. The omission is significant because the sanitized nonviolent *OT* fails to equip students to reflect on the origins of conflicts between whites and Indians. Nor does it offer students any insights into the racial antagonism that fueled this violence. But as John Unruh, Jr., points out, "the callous attitude of cultural and racial superiority was of considerable significance in producing the volatile milieu in which more and more tragedies occurred."

The End of the Trail

Someone can spend two or three hours — or more — playing one game of *OT* before finally reaching Oregon Territory. Once we arrive, the game awards us points and tells us how our life in Oregon turned out. And yet it fails to raise vital questions about our right to be there in the first place and what happened to the people who were there first.

OT hides the nature of the Euro-American invasion in at least two ways. In the first place, the *OT* CD-ROM simply fails to inform simulation participants what happened between settlers and Indians. To the *OT* player, it doesn't feel like an invasion, it doesn't feel wrong. The second way the nature of the white invasion is hidden has to do with the structure of the simulation. For a couple hours or more the player endures substantial doses of frustration, tedium, and difficulty. By the time the Willamette or Rogue Valleys come up on the screen we, the simulated trekkers, feel that we *deserve* the land, that our labors in transit should be "richly rewarded" with the best land we can find.

Data Deception and What to Do About It

OT offers students gobs of information. Loaded with facts, it feels comprehensive. Loaded with people voicing contrasting opinions, it feels balanced. Loaded with choices, it feels free. But the simulation begins from no moral or ethical standpoint beyond individual material success; it contains no vision of social/ecological justice, and, hence promotes the full litany of sexism, racism, and imperialism, as well as exploitation of the earth. And simultaneously, it hides this bias. The combination is insidious, and makes interactive CD-ROMs like this one more difficult to critique than traditional textbooks or films. The teacher's role in analyzing and presenting these devices in a broader ethical context is absolutely vital. Thus teachers across the country must begin a dialogue toward developing a critical "computer literacy." We need to figure out ways to equip students to recognize and evaluate the deep moral/political messages imparted as they maneuver within various computer software programs.

Before choosing to use CD-ROMs that involve people and place, like *OT* — or, for example, its newer siblings *The Yukon Trail* and *The Amazon Trail* — teachers can consider a series of questions. These include:

- Which social groups are students *not* invited to identify with in the simulation?
- How might these social groups frame problems differently than they are framed in the simulation?
- What decisions do simulation participants make that may have consequences for social groups not highlighted in the simulation? And what are these consequences?
- What decisions do simulation participants make that may have consequences for the earth and nonhuman life?
- If the simulation is time-specific, as in the case of *OT*, what were the social and environmental consequences *after* the time period covered in the simulation?
- Can we name the ideological orientation of a particular CD-ROM?

Finally, let me use the example of *OT* to sketch out a number of ways that teachers can begin to foster a critical computer literacy:

- Once we've identified some of the social groups that are substantially missing in a CD-ROM activity like *OT*, we can make an effort to locate excerpts of their diaries, speeches, or other communications (to the extent that these cultures are print-oriented) and read these together.
- We might then engage students in a role play where, as a class, students face a number of Oregon Trail problems.

• Students might be asked to list all the ways that African Americans would experience the Oregon Trail differently than Euro-Americans would — from planning to the trip itself.
• In playing the OT simulation, students could assume a particular racial, cultural, or gender identity, and note whether the choices or experiences described in the simulation make sense from the standpoint of a member of their group.
• As we share with students the social and ecological costs of the Oregon Trail, we could ask them to write critical letters to each of the "pioneers" they portrayed in the simulation.
• A Native American elder or activist could be invited into the classroom to speak about the concerns that are important to his or her people and about the history of white and Indian relations.
• We could encourage students to think about the politics of naming in the simulations. They could suggest alternative names for the Oregon Trail. Just as with Columbus's "discovery" of America, naming shapes understanding, and we need classroom activities to uncover this process.
• Students could write and illustrate alternative children's books describing the Oregon Trail from the standpoint of women, African Americans, Native Americans, or the earth.
• Now have them "play" OT again. What do they see this time that they didn't see before? Whose world view is highlighted and whose is hidden?

OT is not necessarily more morally obnoxious than other CD-ROMs or curricular materials with similar ideological biases. My aim here is broader than to merely shake a scolding finger at the MECC, producer of the OT series. I've tried to demonstrate why teachers and students must develop a critical computer literacy. It's vital that we remember that coincident with the arrival of these new educational toys is a deepening social and ecological crisis. Global and national inequality between haves and have nots is increasing. Violence of all kinds is epidemic. And the earth is being consumed at a ferocious pace. Computer programs are not politically neutral in the big moral contests of our time. Inevitably, they take sides. Thus, a critical computer literacy, one with a social/ecological conscience, is more than just a good idea — it's a basic skill.

Scoring the Checklist

(continued from page 27)

Count up the number of checkmarks and compare your score with the ratings below to get some feedback on your selection process for electronic materials.

Score Feedback

31-36 Congratulations. You are making a strong and effective effort to select equitable electronic materials for your students. Even so, there are probably a few areas that you should examine and plan to remedy. Use the groundwork you've already established as an underpinning for your efforts.

25-30: Although you have some distance to go to achieve the goal of selecting equitable electronic materials for your students, you probably have developed some awareness of the issues both for yourself and among your district staff. This is an important first step that you can build upon successfully.

20-24: Your district should begin to examine this issue as an area of concern and to assess basic levels of staff awareness. Consider the possibility that staff members are not fully utilizing existing policies and procedures for selecting equitable electronic materials, or that the policies and procedures need to be reviewed and strengthened.

0-19: If your district has not already developed a comprehensive plan for selecting equitable electronic materials, you should do so as soon as possible. Form a planning committee which represents all major groups within the district, and charge the committee with developing specific, time-oriented goals for the completing this project. The plan should begin with a strong statement of intent, if one does not already exist, to develop staff awareness of the problem. Consider obtaining assistance from an outside agency such as the Programs for Educational Opportunity.

Unequal Computer Access and the Achievement Gap

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DESPITE widespread enthusiasm for installing computers in schools and wiring them to the Internet, there is almost no evidence that this will raise student achievement or narrow the achievement gap. Techno-enthusiasm is distracting schools from investing in more challenging teaching and smaller classes, changes which can raise achievement and reduce the achievement gap.

Minority Students Need More Challenge

Schools with more minority students have fewer computers and less Internet access. In 1997 schools with less than 25 percent minority enrollment had 10 students per computer compared to 12 students per computer in schools with 75-90 percent minority enrollment; severely segregated schools (90+ percent minority) had over 17 students per computer (Coley, Cradler, and Engel, 1997).

Since 1984 Hispanics and African Americans have been 10-12 percent less likely to use computers at school than Asian Americans and European Americans (Sutton, 1991; QED, 1996; Wilhelm, 1996; Damarin, 1998). Minority students have also been 11-24 percent less likely to have Internet access. See Figure 1.

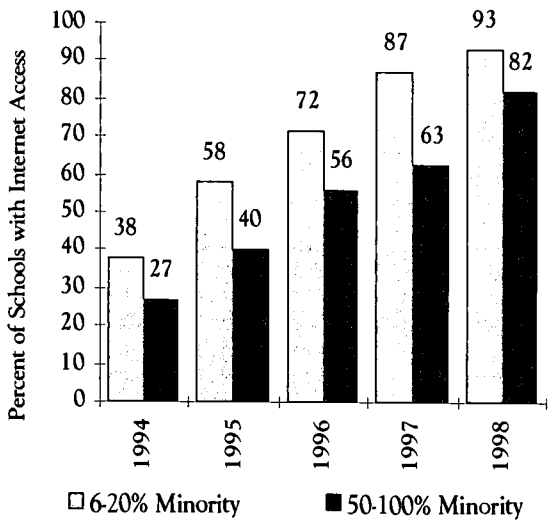
More important than access is how students use computers. Given the chance, African-American and Hispanic elementary and middle-school students tended in 1994 to spend more time using computers than their Asian-American or white classmates (Coley et al., 1997). However, teachers of poor or minority children have long tended to assign remedial 'drill and kill' programs rather than demanding higher order thinking and mastery of challenging concepts (Sutton, 1991). Teachers of minority, poor, and urban students are less likely to have had training in using computers in their classrooms and less likely to ask their students to solve complex problems (Weglinsky, 1998).

Brenda Matthis in her article in this issue (p. 6) gives examples of computer simulations that challenge students to master complex ideas.

Minority students in high school in 1994 tended to take vocational courses in data processing or computer programming, but they were less likely use computers in English courses or to solve problems in mathematics and natural science than their classmates (Coley, Crader, & Engel, 1997). More recently a national survey found that in fall 1998 entering students at all-black colleges were significantly less likely than entering students overall to have taken a computer science class in high school (Sax et al., 1999).

> Teachers of minority, poor, and urban students are significantly less likely to ask their students to solve complex problems.

Figure 1—Minority Enrollment and Internet Access



SOURCE: U.S. Department of Education, NCES (99-017).

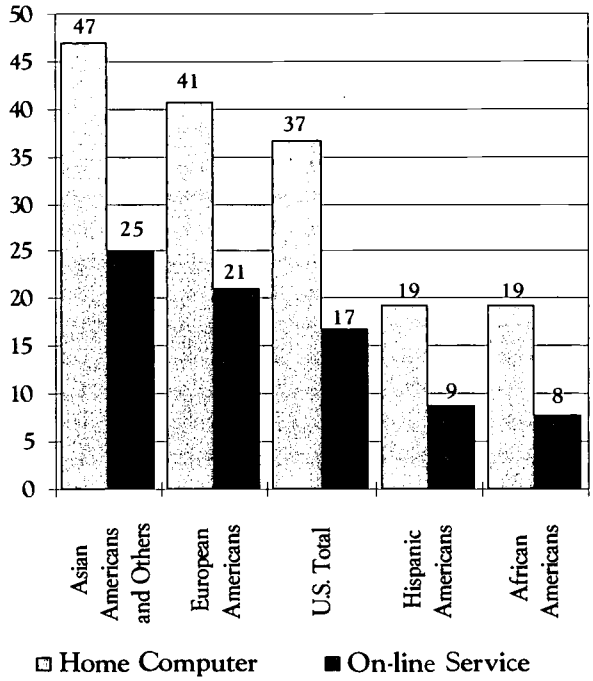
Minority Students Lack Computers at Home

African Americans and Hispanics face even greater disparities in access to computers and the Internet at home than at school. They are about 20 percent less likely than European Americans, Asian Americans, or other minority groups to own a home computer (NTIA, 1998; Weglinsky, 1998). See Figure 2.

Hoffman and Novak (1998) found an even bigger gap of 40 percent in access to home computers between African-American and European-American high-school and college students. In contrast, Wilhelm (1998, April) reported a smaller gap in home computer ownership between Hispanics and Anglos than did the other researchers cited above.

When African-American children had

Figure 2--Percent of Homes with Computers and On-line Service by Race and Ethnicity



SOURCE: NTIA, U.S. Dept. of Commerce, 1998. "Others" includes Native Americans, Pacific Islanders, Aleuts, and Eskimos.

access to home computers according to a 1996 survey, they were enthusiastic users, just as they were at school: 53 percent of African-American fourth-graders used their home computers at least once a week, significantly more than the 36 percent of Asian Americans, 33 percent of Hispanics, and 29 percent of European Americans who did so. Using a home computer does not ensure success at school, however, and extremely high levels of use could even be counterproductive, particularly for elementary students (Weglinsky, 1998).

Like the gap in computer ownership, the gap in Internet access at home is substantial. African-Americans and Hispanics were 13-17 percentage points less likely in 1997 than European Americans, Asian Americans, and others to have on-line service (NTIA, 1998). See Figure 2 above.

Similarly, Hoffman, Novak, and Venkatesh (1997) found a racial-ethnic disparity in Internet access of 9-11 percentage points. And again, Wilhelm (1998, April) found a somewhat smaller gap for Hispanics in home Internet use than did the other researchers.

A large national survey in fall 1998 (Sax et al., 1999) found that entering students at African-American colleges and universities were 2-7 percent less likely to have used the Internet for research or homework and 21-24 percent less likely to have communicated via e-mail, at school or at home.

Hoffman and Novak (1998, April 17) found that African-American students in high school or college were less likely than white students to have used the World Wide Web in the past six months (31 percent versus 59 percent), and the gap was widest for students with no home computer. The authors suggest that African-American students may have less access to technology resources in their neighborhoods.

In sum, the racial and ethnic disparity in home computer ownership is about 20 percent, while estimates of the disparity in home Internet access range from 2 to 29 percentage points.

Girls Need an Encouraging School Climate

Girls have unequal access to computers at school in three areas: less frequent computer use, lower enrollment in computer classes, and less comfort in using the Internet. Numerous studies show small but consistent gender differences both at school and at home (Sutton, 1991; Reinen & Plomb, 1997; Kirkpatrick and Cuban, 1998; Chiaramonte, 1999).

Teachers of eighth-grade girls were significantly less likely in 1996 to report professional development in technology use than teachers of boys (Weglinsky, 1998). Females were also less likely than males to take computer literacy and advanced computer classes and to use computers to solve math and natural science problems, but they were more likely than males to use computers for word processing or in English class (Schofield, 1995; Coley, Crader, & Engel, 1997; AAUW, 1998). Nationwide about eight percent fewer women than men who entered college in fall 1998 had taken a half year of computer science (Sax et al., 1999).

What are the reasons for these disparities? Researchers suggest lack of female computer science teachers, putting computer science in the male dominated math department, focusing too-narrowly on programming, using stereotyped course materials and classroom examples, and too few girls in the computer lab where a hostile climate and aggressive boys verbally and physically discourage girls from participating (Shashaani, 1994; Schofield, 1995; Kirkpatrick and Cuban, 1998).

The Internet itself can seem hostile to girls. Entering female college students in fall 1998 were more likely than their male classmates (52.6 versus 32 percent) to agree that "material on the Internet should be regulated by the government" (Sax, et al., 1999). In taking this preference of females into account, however, we should not allow girls any less freedom than boys. Fear of

pornography on the Web and predators on the Internet has caused many school districts to worry about their liability for negligence if they do not protect their students (Prince, 1997). Many districts have established acceptable use policies which set ground rules for student use of the Internet including what types of sites and newsgroups should not be accessed. More controversial measures, such as electronic filtering programs which block student access to selected e-mail addresses and Web sites, are becoming common (Rodberg, 1999). School districts need to guide student access to the Internet, but they should seek an appropriate balance for all students between freedom and responsibility.

> Fifty percent of the general public believe that having computers in every classroom will improve student achievement. . . . only 13 percent of teachers agree.

Girls Use Home Computers Less than Boys

The gender gap in home computer use continues, while the gap in Internet access seems to be narrowing somewhat. U.S. parents say they encourage both sons and daughters to use computers, but fewer girls than boys actually use computers at home (Reinen & Plomb, 1997). A spring 1998 Roper survey found teenage girls were 2 percent less likely than boys to use computers at school, 8 percent less likely to use them at home, and 7 percent less likely to have their own computer (Chiaramonte, 1999).

In 1993 the entering University of Michigan class had 18 percent fewer females than males who had used the Internet from home (Eaton, 1994). In spring 1998 teenage girls were using the Internet more than boys in some ways: to chat, send e-mail, find entertainment information, and answer surveys; boys played games on line, got sports statistics, and downloaded software (Chiaramonte, 1999). A national survey of new college students in fall 1998 still found a gender gap of almost 4 percent in communicating via e-mail and a 3-12 percent gap in other uses (Sax et al., 1998). See Table 1.

Table 1—Internet Use by Entering College Students

Type of Use	Men	Women	Gap
Communicated via e-mail	68.0%	64.2%	3.8%
Did Research/Homework	84.5	81.6	2.8
Took part in Chat Room	58.0	51.1	7.9
On-line Computer Games	85.3	76.2	9.1
Other Internet Use	79.3	67.4	11.9

SOURCE: Sax et al., 1999.

Thus, females still use computers 2 percent less at school, are about 7-8 percent less likely to use a computer at home, are 8 percent less likely to have a computer of their own, and use the Internet 3-12 percent less than males.

Computers Have Not Raised Achievement

Fifty percent of the general public (and 75 percent of African Americans) believe that having computers in every classroom will improve student achievement (Rose et al., 1997); 88 percent of school superintendents agree (Gordon S. Black, 1998). The omnipresence of computers in the work place has also convinced parents that they are important to their children's future (Tyack and Cuban, 1995). Students themselves, whether African-American, Hispanic, or white, believe their future lies in learning more about computers (Peter D. Hart, 1997).

However, only 13 percent of U.S. teachers agree that access to computers and the Internet will help their students learn (Harmon, *New York Times*, 1997, Oct. 25). Research supports the teachers' skepticism. Computer-assisted instruction improves learning on specific tasks and in the short run (Kulik & Kulik, 1991), but when the same teacher provides both the computerized and conventional instruction, the differences become smaller and disappear over time (Clark, 1994).

Kirkpatrick and Cuban (1997) report that school experience with computers is particularly important for girls who are more likely to encounter technology there for the first time than at home. School experience with computers seems to improve girls' attitudes toward and confidence in using computer technology, but it doesn't necessarily raise their achievement.

Too much technology use at school can even have a negative effect. Fourth-graders and eighth-graders who used computers in school at least once per week scored significantly lower on the 1996 NAEP mathematics test than other students (Weglinsky, 1998).

Debra Viadero (1997) sums up the impact of technology this way: "Many educators are banking on the belief that technology improves student achievement. In reality, though, research on its effectiveness offers, at best, mixed results" (p. 1).

Computers Won't Fix the Achievement Gap

Unfortunately, simply providing equal access to technology will probably not reduce the achievement gap for

minority students and girls. In reviewing a decade of research on computers and equity Sutton (1991) wrote:

> Computer use during the 1980s did not bring education closer to equal educational opportunity. Rather, it maintained and exaggerated existing inequities in education... Children who were minority, poor, female, or low achieving were likely to be further behind after the introduction of computers into schools (p. 494).

By itself, technology did not contribute to equity, but Sutton went on to say that "children who learn with difficulty may particularly benefit from instruction that focuses on conceptual understanding and solving novel problems" (p. 496). If technology could be used in this way, it might yet contribute to equity.

Constructivist educators like James Gardner (in press), Barbara Means (1995, 1997), M.D. Roblyer (1997) are seeking to integrate technology into the classroom in ways that challenge students at risk. They believe that multicultural and diverse students need instructional activities relevant and meaningful to their experience, not more drill and practice.

Technology should provide children with opportunities for cognitive growth and development through exploration, unstructured learning, and problem solving (Roblyer et al., 1997), and teachers should "break away from . . . discrete academic disciplines, repetitive drill, short periods of instruction, and teacher led lessons" (Means, 1997, p. ix-x).

In this issue Martha Adler (p. 9) and Tasha Lebow and David Dugger (p. 31) describe constructivist teachers in culturally diverse classrooms who are using technology to make learning meaningful for all students.

In tandem with constructivist teaching, computer technology can add to students' perception that their work is authentic and important, increase the complexity students can deal with successfully, enhance motivation and self-esteem, instigate more collaboration among students, and even improve attendance (Means, 1997). Furthermore, technology can "positively influence the social environment of the school, reducing teacher and student absenteeism and increasing morale" (Weglinsky, 1998, p. 34).

Thus, using technology in the classroom seems to improve student attitudes and the social environment, but it has not been shown to raise achievement or reduce the achievement gap. Means (1997) is impatient with policy makers who want to know once and for all whether an investment in networking and computers will pay off in comparison to other school improvement options. Her study of nine school sites revealed some positive student learning results, but the differences were not large, nor could they "be attributed to technology rather than to higher motivation, better teachers, enhanced camaraderie, or more complex tasks" (p. 170).

Similarly, Weglinsky (1998) found that students who used computers for higher-order learning had significantly higher math achievement scores than their peers, but his one-shot analysis of survey data had no prior measures of achievement, "making it difficult to rule out the possibility that positive educational outcomes are conducive to certain aspects of technology use rather than the other way around" (p. 33). Even when teachers challenge their students to use technology to develop higher-order thinking skills and explore complex concepts, their students' success may not be due to the technology; it is quite possible that "students do better when teachers tend to teach higher-order thinking skills, regardless of the medium" (Weglinsky, 1998, p. 33).

Technology seems to improve student attitudes and the social environment, but it has not been shown to raise achievement or reduce the achievement gap.

Unfortunately, minority and female students are less likely to receive such instruction, with or without technology (Coley et al., 1997; AAUW, 1998).

Challenging Teaching and Smaller Classes

If using computers does not raise student achievement or reduce the achievement gap, what should we do?

- First, we should thoughtfully resist the pressure from techno-enthusiasts to spend more and more scarce tax dollars on computers, software and Internet connections.
- Second, we should help teachers learn constructivist, project-focused ways of using technology that will challenge our children to develop higher-order thinking skills and become resourceful investigators.
- Third, we should hire more teachers so we can have smaller classes. Tennessee's Project STAR, a rare controlled experiment, showed that smaller classes in grades K-3 helped all students achieve, and smaller classes were particularly helpful to minority students (Finn, 1998).

We should buy enough computers for our schools so all students have equal access, but we should also offer more challenging teaching and smaller classes if we are serious about reducing the achievement gap.

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Successfully Merging onto the Information Super-Highway

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COMPUTERS have transformed how schools look and how teachers teach. Libraries have evolved into media centers, with electronic card catalogs and computer workstations. Rows of monitors stare out of classrooms and computer labs. Teachers and students have access to an entire world of resources through the Internet. E-mail access to experts, primary research, and extensive libraries is only a few keystrokes away. Reading comprehension and language skills are augmented by skills in making multimedia presentations. Virtual communities transcend barriers of time and space. Science and history lessons use software simulations that allow students to 'see' physical, chemical, or historical changes that previously could only be imagined.

Computers promise enhanced learning, but they may also stratify our society into a rigid caste system based upon who is and who is not computer fluent. Technology invades all aspects of our work, advanced study, and basic life. Hence, it is urgent to equalize access to technology in schools to guarantee that all students become literate, competent computer users. Our girls, students of color, students living in impoverished families, and students who are linguistically or culturally different risk relegation to second-class work and educational status unless we address disparities in resources, access, and opportunities in their school experience. (See Ted Wilson's article on page 26 of this issue).

The mad push to join the computer age can feel very overwhelming to educators, but our collective knowledge about good teaching and learning can direct us down the new superhighway. Good computer education is not drastically different from what we already know about quality teaching and learning. The challenge, as with any new instructional tool, is to integrate computers with established educational objectives and practices. Lessons learned in the past can inform best practices with new technologies. Using basic principles learned through past educational practice, this article will propose strategies that can help schools successfully evolve in this dawn of the technological age.

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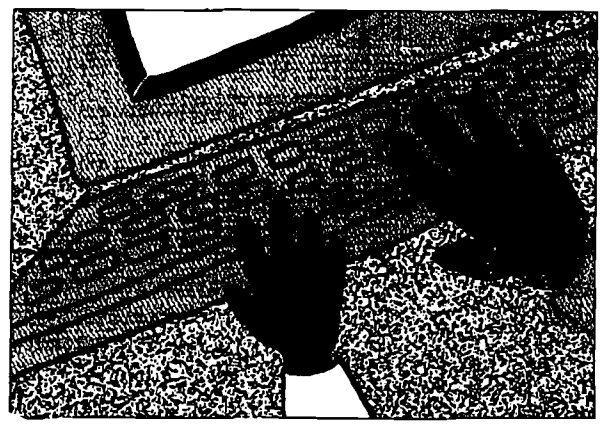
Using Old Lessons with New Technology

Focusing on developing basic literacy skills in the early grades is still the best foundation, but technology has added a new skill to the list of essentials: keyboarding. Until a student (or adult) can type at 35 words per minute with an 85 percent accuracy rate, she /he is likely to be held back from successful engagement with computers. Schools and hardware developers should develop strategies for building students' keyboarding skills in the early grades, several years earlier than most schools now introduce regular keyboarding courses.

For example, inexpensive, smaller keyboards could be designed for little hands, just as Dr. Shin'ichi Suzuki, who revolutionized violin instruction, created violins proportionally sized for little children. Suzuki proved that young children quickly accomplish complex, demanding skills when the instructional approach and the equipment are geared to their developmental age. By incremental, positive skill development and by instilling high expectations, Suzuki drew upon the natural drive in young children to master an activity that produces something (a sound, a printed word, or a graphic). Similarly, early keyboarding skill development can benefit fine motor skills, eye-hand coordination, and kinesthetic/ cognitive connections that will enhance reading skills.

Successful computer-based lessons integrate concepts and content from standard learner objectives with new instructional delivery methods. Identifying relevant skills or concepts and evaluating how the technology can enhance learning goals are important



Courtesy of What Works, San Rafael, CA

considerations if the technological evolution of the instructional process is really going to be productive. For example, most students enjoy the act of writing but often get frustrated during the tedious editing phase. Word processing editors and spell-checkers take much of the tedium out of rewriting and editing and keep students engaged as they see their polished writing spring forth.

Mechanically, though, the act of writing changes when one moves from paper to keyboard. A wise teacher identifies strategies that enhance student writing at the keyboard: maintain the flow of the writing process without interruptions to fix typos and use the 'fix it' functions of the computer only after there is a substantial amount of writing, rather than correcting small passages. These tips help students discharge their ideas quickly and streamline both composing and editing.

Students use computers primarily as individuals, but cooperative learning works beautifully in computer-aided instruction. Small groups of students can gather information from the Internet on various aspects of the same large topic and can then coordinate it into one memorable and comprehensive project. Writing projects can benefit from the power of cooperative learning, as computers allow all kinds of enhanced connections for multiple authors or sources. Cooperative group reports, poems, or stories, where each student supplies a section, are easy with 'cut and paste' editing on the computer.

A wise teacher identifies strategies that enhance student writing at the keyboard.

Organizational Skills for Smart Investigators

If the goal of education is to create critical thinkers who can solve complex problems by using a myriad of strategies, then students need to develop problem solving strategies and computer-related problem solving skills. Teachers should help all students develop the skills of smart investigators, providing them with the information and experience necessary to take thoughtful, reasoned risks and to experiment with the capabilities of the software and equipment. This empowers students to be fluent computer users and independent problem solvers.

Often the primary difference between good and average students is their ability to organize their thoughts and efforts to accomplish specific tasks. Computers, the Internet, and other high tech resources offer us more information and more ways to format information than we have ever had before. Though good organizational skills are essential for efficient work in any medium, it is especially critical that computer users have a clear vision of the question they are examining, the kind of information that is useful (and that which is extraneous), and how they will structure the final presentation or outcome. Without a clear vision, students can waste vast amounts of time finding, retrieving, and reorganizing primary data or information and become swamped by the flood of information that is now so accessible.

Efficient users are always strategic in their approach. They organize spreadsheets of original data sets and group files of articles pulled off the Internet so as to increase the efficiency of producing a final product. Long range plans, good visualization skills, and familiarity with the options available in the software make the difference between frustration and success.

The computer itself can help students develop organizational skills. Many of the major computer applications, such as word processing, spreadsheets, and using the Internet for research, are specifically designed as information organizing tools. If teachers promote regular habits of creating and organizing folders and files and of using the bookmark function on the Internet browser (and organizing one's bookmarks into folders), students can use their time with the computer more efficiently and learn organizational skills that will be useful in other areas.

Teaching beginners how to make proper use of the style sheet functions on word processing applications helps them become more efficient computer users. Especially when working with beginners, teachers are wise to provide them with specific templates for formatting their assignment. Otherwise, students lose time trying to make decisions about type font and size, margin widths, etc. When school staff agree to require consistent formatting requirements and when (and in what courses) they will teach specific applications, they avoid instructional duplication and expand their opportunities to integrate content areas. Such coordination and advance planning have become more important in creating a quality learning environment. It has never been more important that teachers be able to meet in teams to share strategies and activities and coordinate their work.

Critical Thinking Skills

Students have always had to learn how to select, comprehend, reflect upon, manipulate, organize, synthesize and evaluate information, but never have they had the wealth of possibilities that are before them now. Critical thinking skills—including questioning skills— are essential to avoid being swamped by the information deluge technol-

ogy brings us. Qualitative and ethical considerations must underlie the evaluation and use of information. When weighing two conflicting 'facts' drawn from the Internet, students should understand the potential difference between a web-site address that ends with <.edu> that is affiliated with a university or research facility and one that ends with <.com> that typically has a product to sell. Here is an important new venue in which to teach the old lesson, consider the source, and to develop smart investigators with good research skills.

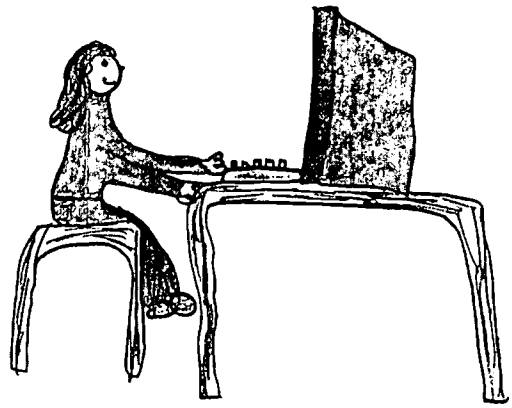
High Expectations of Success for All Students

Teaching strategies to develop students' problem solving skills must address the patterns of gender difference described in Eleanor Linn's article on page 14 of this issue. When they do not get results, boys typically begin to experiment, searching for a useful command somewhere (often using trial and error). They may create more trouble for themselves, but they are also learning more about the technology through their active curiosity. Girls typically are not as confident, curious, or aggressive in searching for their own solutions to computer tasks, so they may require more one-on-one teacher time. Too many girls do not benefit from the boost in self esteem inherent in finding their own way out of computer problems.

Past efforts to build girls' confidence and interest in nontraditional areas provide helpful insights. The gender equity lessons we have learned about that crucial, yet nebulous area of classroom climate teach us that girls must first feel comfortable enough to explore, to ask 'silly questions,' to make mistakes, and to suffer the pitfalls of experimenting in a new sphere. In raising girls' participation in athletics, math, and science, we have found it effective to reinforce their skills and provide experiences that help them express their own voices and believe in their capabilities. We also know that contact with positive role models—for example, women technology professionals who are successful and excited about their work—is a powerful way to counter the stereotype that technology is a male-only domain.

> Empower all students with the confidence and the necessary skills to solve their own computer problems.

Teaching girls the basic tricks of managing computerized tasks encourages them to work more independently and confidently. Bolstering basic communication skills proved useful in assertiveness training for girls, and similarly teaching basic computer skills changes girls' behaviors and attitudes. For example, fear of experimenting can be alleviated if students learn to use commands like 'edit/undo' to recover lost work, make a habit of saving their work often, and remember that they can always back step by using the command 'revert to an earlier version' when things really go wrong. Such strategies empower girls by giving them an escape to a safe place. It is critical to empower all students with the confidence that they can solve their own computer problems. Otherwise, the computer remains an incomprehensible magic box that is safe to use only when an 'expert' is around to assist them.



Courtesy of Renate Schulz-Zander, Institute für Pädagogik der Naturwissenshaften, Kiel, Germany

Conceptual Understanding

To become truly computer fluent—that is to go beyond computer literacy to in-depth comprehension—people need to understand how a computer 'thinks', which is very different from how humans approach the same tasks. *Off & Running: The Off-line Computer Activity Book* by Tim Erickson (1984) is an outstanding resource for expanding understanding. As in all EQUALS products, the focus is on problem-solving skills, the thinking process (of both computer and human brains), and cooperative group process. Not a single piece of hardware or software is required to do the innovative activities that build understanding of the concepts of programming and of the problems people tend to have as they interact with computers. All the activities are designed for cooperative groups, a familiar method for teaching problem-solving skills. Some of the activities, like cross-cultural simulations, have groups of people simulating the ways in which computers work with language and information to accomplish typical tasks, which is very different from the

human approach. As in more typical diversity activities, the lesson learned is that the real power in effective collaborations between human and computer comes from effectively negotiating and utilizing the differences in approach, perspective, and thinking skills.

Expanding Classroom Discourse

For decades, educators have confirmed that participation in classroom discussion directly correlates with students' educational outcomes. The Sadkers, John Goodlad, and other important researchers who have analyzed the issue extensively found the same results in all settings: the higher the frequency and quality of students' classroom participation, the more success they experience in related academic work. As equity research has documented too often, in too many settings, we still see disturbingly disparate patterns of classroom discussion. In a typical classroom discussion, only a few students participate with any depth or frequency, and these students are most often white and male.

Chatroom-like discussion groups can be a terrific incentive for students to increase their keyboarding skills and to participate more in class discussions. Because students are all burning to contribute to the conversation, their fingers are actively engaged. Robin Wax (e-mail: wax@aaps.k12.mi.us), of Ann Arbor (MI) Pioneer High School, has had great success engaging basic skill students in American history discussions utilizing this approach.

After introducing the period of history, the issues involved, and the key players, Wax took her class into one of the school's networked computer labs. Here they participated in a chatroom-like discussion which allowed the students to write to each other simultaneously, assuming assigned roles for the duration of the discussion. In discussing the Louisiana Purchase, for example, each student assumed the point-of-view of either a plantation owner in the South, a hopeful pioneer, a northern city dweller more interested in improving existing towns than in expanding the frontier, or an Indian leader whose lands would be invaded and seized by new settlers. Students engaged in a spirited and thoughtful debate of the key questions of the era. Because the chatroom created virtual time for discussion, many voices could speak simultaneously, and everyone in the class was actively involved.

This fairly low tech approach had a profoundly positive effect on instruction. Not only did it engage more discussants, but it provided an anonymous, safe environment for role-playing, experimenting with alternative voices, and trying virtual identities in a controlled setting. This technique has real power for personal discovery without the fear of potentially embarrassing public display which seems to inhibit many adolescents from trying new roles and voices.

Wax gave her high school students pre- and post-tests to gauge their attitudes about school, the course, computers, and writing, and to assess their skill levels. At term's end, many said they had enjoyed the class much more than they had expected. Their writing and computer skills greatly improved through this low-tech integration of computers and teaching. In the post-test evaluation many students expressed a rekindled interest in the study of history and the writing process. Computer conversations expanded the traditional mode of discussion for classrooms because of the highly interactive but unthreatening nature of virtual relationships.

Developing Teacher Capacities

Though our society has quickly embraced the information age and all the new machinery that it includes, there is no broad-based consensus that all students should receive a technologically enriched education. School districts and even individual teachers have been fending for themselves, gathering hardware and software, gaining skills and experience, and developing their own methods for using technology in their classrooms with only marginal aid from government, business, techno-experts, or higher education. Educators are eager to infuse technology into teaching to make use of the profound advantages of computer-aided instruction. Castoff hardware considered obsolete by the business world is used in classrooms in innovative ways. While much of this is of good educational design, quality planning is critical to its successful implementation.

> The most vital need is training for teachers in how to integrate computers into their classes.

While schools scramble to fill classrooms and labs with computer equipment, the most vital need is training for teachers in how to integrate computers into their classes. The business world typically spends 30 percent of staff time and resources on research and training, but in public education funding for staff development evaporates across this country. Educational leaders and advocates must work to change this funding policy. Teachers from various levels and content areas need structured time to discuss their common concerns, to

share effective strategies, and to develop new instructional approaches would help to infuse technology into teaching as well as to integrate curriculum content.

However, the model of large group workshops led by individual experts is too limiting to address the diverse needs of our teachers. Somehow districts must find ways to offer a full spectrum of support for teachers to accommodate the high degree of variation in individual teaching styles, course content, grade level, and experience with technology. The broad options now available with computers, software, and networking mean that traditional staff development approaches must also evolve.

Some districts have met the challenge by adopting technology training models that are similar to peer coaching, and these one-on-one informal consultations with an educational computer 'expert' work well. Often this person is also a teacher who has broad experience and success in integrating computers into instruction and who is given released time to assist other staff members. Small groups of teachers meet with this consultant, each bringing content and a conceptual plan to adapt the material into a computer-aided lesson. Such project-based staff development has the same advantages as this kind of instruction in our classrooms: it demonstrates basic ideas through real applications, promotes active engagement of the learner, and is more relevant to the learners' needs.

The shortage of multicultural and gender-fair software could be rectified if more educators got directly involved with techno-corporations.

NetDay: Accessing Community Support

One barrier confronting the infusion of computers into classrooms is the physical and fiscal challenges of providing all classrooms with adequate computers and Internet access. Schools designed and built long before the computer age and limited financial and human resources are just two of the barriers to cross.

A promising method to meet this challenge is another long-standing hallmark of good education: active community and business support. Designed as a collaborative project to bring corporations, schools, and community volunteers together to wire schools for Internet access, the NetDay project began in California in 1996. In the first year it mobilized 20,000 volunteers to install 6 million feet of wire in 2,600 schools on one day (*Education Week*, 1996, Aug. 7). Because the wires for Internet connections are low-voltage fiber optic cables, they do not present the safety concerns associated with higher-voltage wires. Working with the skilled technical support of corporate and trades co-sponsors, trained NetDay community and parent volunteers pulled the cables and hooked up the proper intermediate switches and plugs to provide Internet access to more classrooms. Kits of hookup supplies with hublets, switches, wires, and support materials were available through the national NetDay organization at reduced cost.

After its promising beginnings in California in 1996, NetDay grew to become a national project, but has since received only intermittent support from national and state educational leaders. On NetDay 1997, for example, only a few independent school districts in the Great Lakes states participated, and no area governors or state legislatures endorsed it. NetDay offers a realistic way to overcome the barriers of unequal infrastructure among districts and to realize the dream of wiring all classrooms.

The plan for subsequent NetDays to occur across the country is in jeopardy. An Internet search on "NetDay" will draw more sites from New Zealand and other countries that are emulating this approach than from states in the U.S. The project has the potential to raise the level of computer and Internet engagement for our teachers and students, so one would hope that major technology corporations would rush to become involved. Instead, the fear of lost profits from NetDay projects that might otherwise be realized by technology firms, unions, and corporations has led to the application of political leverage to keep many states and local districts from participating. In large communities it is essential to have the support of the local construction trades unions to avoid any negative reactions and to draw the participation of skilled people. The National NetDay project offers information, sample recruitment letters, public service announcements, and other resources at <www.netday2000.org> for people interested in mounting a local effort.

Advocacy

The uncertain future of NetDay and inaction by Congress on the "E-rate" program to expand universal service to schools and libraries demand that parents and educators advocate for our children. For example, the shortage of multicultural and gender-fair software could be rectified if more educators got directly involved with techno-corporations.

The lack of software that is engaging and relevant to girls, students of color, and language minority students is in part an outgrowth of the free market system. No doubt it is also directly related to who makes decisions in the corporate world and on what criteria they make them. A key factor is the continuing underrepresentation of women and people of color in powerful positions in the technological arena. Software designers develop products to interest the people they believe are their engaged audience, and they are less interested in drawing in new, less sophisticated users. Engaged, active computer users are assumed to be white and male, so new products and marketing strategies reinforce traditional stereotypes.

Concerned teachers and parents must forcefully advocate for software that engages all kids. The racial stereotypes and historical inaccuracies in 'quality' educational software such as the Oregon Trail (see Bill Bigelow's article on page 22) result because the designers do not have the perspective of equity advocates, and so they unconsciously perpetuate the biases they were taught in their schooling. Their ignorance is no defense, however, and the mission of educators and parents must be to build their awareness and commitment to equity and quality. Software developers need to know they have missed major untapped markets—parents and teachers who are desperate for effective, multicultural/gender- and culturally-relevant software.

This task also can be greatly informed by past lessons and our struggles in recent years to get textbook and trade book publishers to recognize the power, value, and profitability of multicultural books. We can't expect all software to be representative of all interests, for the inherent value of computerized sources is that software can be specific, elaborate, and finite. With textbooks or course reading lists, we learned over time that there are sometimes unexpected costs to holding every title to the higher standard of multicultural representation. The loss of human characters in all elementary readers, in favor of non-gender specific animal characters, was not a quality fix to the lack of girls and women in active roles in stories and novels. It is likely that we serve the goal of multicultural education best by ensuring that supplemental software that is culturally focused comes into the lives of all students. This allows for higher quality, more in-depth content, instead of trying to include everyone in a token manner. We must take necessary steps to ensure that every student is exposed to such diverse, vibrant content.

As with biased print materials in classrooms, many teachers have found that discussing historical biases and stereotyping patterns with students is a powerful aid to their understanding of and commitment to social justice. By analyzing the latent messages in the advertisements and marketing strategies used by computer companies and software producers, students become more critical consumers. It is an important life lesson to understand how subtle stereotyped messages, spoken with false authority, can be internalized dangerously by a naive audience. Building students' awareness of these messages gives them a form of self-defense.

The new technology itself can be invaluable in our advocacy efforts. E-mailing legislators, corporate leaders, and other power-brokers is extremely convenient. Web sites have been created specifically to inform people about tech-equity issues and to facilitate advocacy. For example, information on NetDay, the E-rate, and other educational telecommunications issues, with an easy e-mail format for sending comments to the FCC, governmental leaders, and other decision makers can be found at <www.mightymedia.com/netday>.

> Teachers and parents are still the best people to determine what is best for students.

Though we are at the dawn of the computer age, our collective wisdom continues to serve us well. Despite the mind-boggling speed and depth of resources that computers offer schools, good computer-based education is really no different from good teaching. There is no substitute for creating informed, long-range plans and curricula designed to meet clearly defined learner goals and objectives. We must be continually vigilant against unequal access and bias in instructional materials. Teachers and parents are still the best people to determine what is best for students and to serve as their advocates in direct engagement with the technology industries seeking to influence how and what students learn. Our child-centered, educator's instincts, honed through decades of determining what is best for students, can help us find our way through the pitfalls of schooling in the computer age.

References

Erickson, Tim. 1986. *Off & Running: The Computer Offline Activities Book*. Berkeley, CA: EQUALS; 510-897-5036.

Education Week. 1996, Aug. 7. "Spools of Wire and a Mission: NetDay Founder Turns Up the Heat"; <www.edweek.org/ew/1996/41gage.h15>

Recommended Resources for

Computer Equity @ School

Eleanor Linn, Senior Associate Director, <elinn@umich.edu> and Ted Wilson, Editor, <tywilson@umich.edu>

WE chose these resources because they are readable, useful to educators, and focus on equity. Many are available through the Internet, though addresses change.

Computer Technology and Student Learning

Many questions are still unanswered about the educational advantages of computers. We have some idea of what works and what doesn't, however, from these resources.

Healy, Jane. 1998. *Failure to Connect: How Computers Affect Our Children's Minds—For Better and Worse*. New York: Simon & Schuster.

Educational psychologist Healy observed many young children, teachers, and school administrators using computers. She advises parents to be skeptical of the value of surfing the Internet and of so-called educational software, most of which shows little knowledge of child development or educational philosophy. Her findings are born out by Weglinsky (1998).

Means, Barbara, and Kerry Olson. 1997. *Technology and Education Reform: Volume II, Case Study Reports*. Washington, D.C.: OERI, U.S. Department of Education.

Means describes how nine schools attempted to combine educational reform and technology to reach all students. She says schools must support teachers in learning, using, and sustaining computer work; handle student and equipment safety; cope with constant change; and plan consistently across schools and age levels. Part of a three-volume study; see also <www.ed.gov/ pubs/EdReformStudies/EdTech>.

Weglinsky, Harold. 1998. *Does It Compute? The Relationship between Educational Technology and Student Achievement in Mathematics*. Princeton, NJ: Educational Testing Service Policy Information Center; <www.ets.org/research/pic>.

Analyzes NAEP scores, computer use, and school climate and reports three very important findings:

- African-American children use computers more than white children
- teachers tend to assign African-American children to drill and practice with computers and to ask white children to use computers to learn challenging concepts
- computers are less helpful to elementary than to middle-school and high-school students in mastering mathematics

Thought-Provoking Reading

These pieces don't tell you what to do. Read them when you have time to think about the larger issues and discuss them with colleagues. We think they're worth the time.

De Vaney, Ann, Ed. 1998, Winter. *Theory Into Practice*—Special Issue on Technology and the Culture of Classrooms. 37(1).

In this publication Suzanne K. Damarin writes on the convergence of technology and multicultural education in schools (a theoretical mis-match that seems to work quite well), Henry Jay Becker on technology obsolescence, John Hollenbeck on computer conferencing, Nancy Nelson Knupfer on gender and advertising on the Web, Joan H. Hanor on girls' interactions with computers, and the editor, Ann De Vaney, on the need for educational technologists to be sensitive to diverse students.

Lockheed, M., Ed. 1985. *Sex Roles: A Journal of Research*—Special Issue: Women, Girls, and Computers, 13(5/6). Plenum Press.

Lays out the main problems of gender and computer use, including the different ways in which men and women use computers at work, the gendered ways in which computers were introduced into schools, stereotypical advertising images of people using computers, the gender imbalance in computer camps and in students' attitudes about computers, and how to create gender-fair computer environments. Old but good.

The Equitable Technology Manager

We offer managers and policy makers a few helpful resources on technology access, acquisition, and training.

Becker, Henry Jay. 1994. "How Exemplary Computer-Using Teachers Differ from Other Teachers: Implications for Realizing the Potential of Computers in Schools." *Journal of Research on Computing in Education*, 26(3):291-321.

Necessary reading for anyone setting up a school technology program or puzzled at why they have not had the success they hoped for. Becker surveyed 516 teachers, identified 45 as exemplary computer users, and analyzed the factors crucial to their success: collegiality among users, support for using computers for consequential activities, resources for staff development and computer coordination, and smaller class sizes. Surprisingly, exemplary teachers were not over represented in high socioeconomic communities or in classes of high-ability students. One of many excellent articles on computer technology by this author.

Community Technology Centers' Network (CTCNet); <www.ctcnet.org>; e-mail: <ctcnet@edc.org>.

A network of 250 diverse community centers where people can get access to computers and the Internet such as Plugged In, <www.pluggedin.org>, which seeks to make technology available to a largely minority, low-income community in East Palo Alto, CA. CTCNet provides a map for finding such free or low-cost community access Internet sites in your community, ideas for how to set up such sites, research on their effectiveness, and many other resources.

Warren-Sams, Barbara. 1997. *Closing the Equity Gap in Technology Access and Use: A Practical Guide for K-12 Educators*. Portland, Oregon: Northwest Educational Technology Consortium (NETC); <www.netc.org/equity>.

Published jointly with a regional educational laboratory and an equity assistance center, this book has valuable suggestions for equity planning at the district, school, and classroom level and ingenious solutions for providing alternative access for families without home computers.

Equity Related Classroom Use of Technology

Most educators today still do not have a clear vision of what kind of learning is possible with computer technology. These resources describe equity-based projects which were successful in using computer technology in ways that transformed otherwise dull environments into an active and exciting ones for learning.

Cummins, Jim, and Dennis Sayers. 1995. *Brave New Schools: Challenging Cultural Illiteracy through Global Learning Networks*. New York: St. Martin's Press.

Envisions students, teachers, and parents connected by the Internet and communicating globally across geographical and cultural barriers. Describes classroom-to-classroom projects bridging distance and culture and offers a guide to the Internet for parents and teachers. Emphasizes second language learning and bilingual experiences with the Internet.

I*EARN (International Education and Resource Network), <www.igc.apc.org/iearn>

I*EARN works with educational, youth service, relief, and development organizations to build opportunities for young people to work together to make a meaningful contribution. *De Orilla a Orilla*, described on page 12 of this issue (URL = <orillas-web.upr.clu.edu>), is just one of many electronic communication projects with which I*EARN is a partner.

Pacific Southwest Regional Technology in Education Consortium (PSR*TEC). 1998. *Virtual Power: Technology Education and Community*. Long Beach: California State University; <http://psrtec.clmer.csulb.edu>.

Published jointly by a technology center and a language minority research center serving children in the Southwest. Looks at how technology can expand learning opportunities for under-served populations, and focuses on children of color, language minority children, and children from low-income families. Many excellent ideas for working against racism, using global learning networks, providing community access to computers, and helping students understand social issues.

Sanders, Jo Shuchat, and Antonia Stone. 1984. *Neuter Computer: Computers for Girls and Boys*. New York and London: Women's Action Alliance/Neal Schuman Publishers, Inc.

A classic book of ideas for making computer access and use more gender equitable in any classroom. Excellent for raising awareness among staff, students, and parents.

Shinohara, Mayumi, et al., editors. 1996. *Tales from the Electronic Frontier: First-Hand Experiences of Teachers and Students Using the Internet in K-12 Math and Science*. San Francisco: WestEd; <www.WestEd.org/tales>; ERIC accession number: ED400776.

Inspiring vignettes of teachers using the Internet in math and science classrooms and for their own professional development with specifics on hardware, software, and web sites. In "Tall Shadows" students from different latitudes on earth ponder how their location influences the length and direction of shadows they measure; in "Penumbra" two alienated teenage girls get excited about enhancing images of the Orion nebula.

Teaching Matters, Inc.; <www.tminet.org>.

A non-profit organization dedicated to long-term teacher development in technology. Although their on-site work is focused on New York City schools, their Gold Star Portfolios are an inspiration to all. Their Internet projects are open to teachers and classes in other locations.

International Telementor Center (ITC), Center for Science Mathematics & Technology Education (CSMATE), Colorado State U.—Fort Collins, CO; <www.telemontor.org>.

In 1998, Hewlett-Packard's award-winning E-mail Mentor Program moved to CSMATE in Fort Collins and became the foundation of the ITC which offers students a chance to interact with professionals who volunteer to share their know-how and provide academic guidance to students for 30-45 minutes a week via e-mail.

Electronic Ways to Learn about Equity

Learning how to find and organize the information we want is one of the great challenges of learning to use technology. These electronic resources are good entry points to the major areas of equity in education. Some address the need areas of race, gender, and national origin. Others are specific in their focus. Most have supportive staff behind the electronic scene to help you find what you need.

RA-EQUITY (Regional Alliance-Equity). <ra-equity@nici-mc2.org>.

The premiere e-mail discussion group (listserv) for educational equity. Moderated by Joy Wallace, <joy@col-ed.org>, an experienced equity specialist. Focuses mostly on mathematics, science and technology. Sponsored by the National Institute for Community Innovation (NICI).

Making Schools Work for Every Child, a CD-ROM produced by Eisenhower National Clearinghouse, The Ohio State University, 1929 Kenny Road, Columbus, OH 43210-1079; available FREE on request.

A resource guide in CD-ROM format but with live Internet links and video interface. Contains a vast array of professional development materials in mathematics and science education including articles, activities, case studies, self-assessment instruments, model programs, and state framework documents. The directions for downloading and running the software are clear, and there's good help finding the information you need. Sent to every school district in the country, so your district may already have it.

National Clearinghouse for Bilingual Education (NCBE); <www.ncbe.gwu.edu>.

NCBE offers resources on classroom strategies, advocacy, research, and funding, and links to data bases and other organizations. A monthly newsletter is available via e-mail; to

subscribe send a message to <majordomo@cis.ncbe.gwu.edu> with only "subscribe newsline" in the body of the message.

National Indian Telecommunications Institute (NITI); <numa.niti.org>.

A very useful web site which includes a wide range of lesson plans for K-12 teachers and links to other Native education programs and resources.

AFAS-L (listserv of the African American Librarians/Afro-American Studies Librarians Section of the Association of College and Research Libraries (ACRL)

Gladys Smiley Bell, <gbell@kentvm.kent.edu>, moderates this e-mail discussion forum which covers African-American experience and librarianship as well as race relations and multicultural diversity. To subscribe send a message to: listserv@listserv.kent.edu stating in the message body: "Subscribe AFAS-L first-name last-name."

U.S. Department of Education; <www.ed.gov>.

A huge web site with many interesting parts including data from the National Center for Education Statistics, publications from the Office for Civil Rights, and free materials for classroom use. To receive periodic updates, send an e-mail message to <listproc@inet.ed.gov> with "subscribe edinfo yourfirstname yourlastname" in the message.

Keeping Up with What's New

Electronic resources are constantly changing, and so is the information available electronically. Keeping up is a major challenge to everyone working with technology. As people concerned with equity in education, we must cross boundaries to find what we need.

ISTE (International Society for Technology in Education); <www.iste.org>.

This professional organization seeks to help K-12 educators share effective methods for enhancing student learning through technology and publishes two important journals: *Learning and Leading with Technology* (for classroom teachers) and *Journal of Research on Computing Education* (for researchers). The ISTE web site includes abstracts and sometimes whole articles from both journals and lists special-interest-group newsletters along with a growing list of on-line conferences on computers in education. ISTE also maintains an on-line bookstore. ISTE does not focus exclusively on equity, but you can find good equity information here.

"E-Rate" Universal Service Program, Federal Communications Commission.

Every school that serves children in poverty needs to know about government sponsored reduced rate funding for telecommunications. However, the regulations are complex and the funding levels keep changing. The Northwest Educational Technology Consortium offers an e-rate primer and assistance in filling out the forms at <www.netc.org/fcc>. The Education and Libraries Networks Coalition (EdLiNC) offers up-to-date information on the status of the e-rate program at <www.eratehotline.org>.

Choosing Equitable Software and Web Sites

We looked for an impartial guide to current children's software that reflected both equity and quality learning. We couldn't find one. Most commercial guides are subsidized or sponsored by software and hardware companies, and even those that are independent do not have the equity awareness that we would like to see. We need a top-notch software guide, as articles in this issue by Marta Larson, Brenda Matthis, and Bill Bigelow demonstrate.

We did find a good resource for evaluating information found on the Internet, however:

Kirk, Elizabeth E. 1999. *Evaluating Information Found on the Internet*. Baltimore: Johns Hopkins University; <milton.mse.jhu.edu:8001/research/education/net.html>.

An excellent article produced by a librarian at Johns Hopkins University and meant for adults and older secondary students. Its ideas should be adapted to younger children as soon as they start using the Internet.

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Back issues of *Equity Coalition*:

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- ❑ Fostering Sex Equity in Math
- ❑ Promoting Flexibility in Male Roles
- ❑ Women and Sports

Books, Booklets, and Poster:

- ❑ *America's Hispanic Heritage* ($4.00)
- ❑ *Hispanic Americans in the U.S.,A Bibliography* ($4.00)
- ❑ *Effective Schools: Critical Issues in the Education of Black Children* ($7.00)
- ❑ *Jump Street: A Story of Black Music, A Secondary Teaching Guide* ($4.00)
- ❑ *Magnet School/Title IV Programs: Proceedings of the 1993 Conference* ($4.00)
- ❑ *Remember the Ladies! A Handbook of Women in American History* ($5.00)
- ❑ *Ten Commandments for Black Educators*, a laminated poster, 17" high x 5-1/2" wide ($4.00)
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- ❑ *A Yearbook of Holidays & Observances: A Multicultural Perspective of Observances in the U. S.* ($8.00)
- ❑ *Bibliography for Yearbook of Holidays* ($4.00)

Single copies of newsletters are free. The price of books and booklets covers only the cost of printing and mailing. *Tune In to Your Rights* and *Agarra La Onda* are also available at $400/box of 200. Make checks payable to "The University of Michigan." To order, mail this form to the address at left below. You may also contact us at:

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