

Developmental Risks: The Hazards of Computers in Childhood*

“We need to continually examine what succeeds and fails, and why. And we should do so before we deploy any technical approach on a grand scale.”

—Michael Dertouzos, director of MIT’s Laboratory for Computer Science, writing about educational technology in *What Will Be: How the New World of Information Will Change Our Lives*.

MANY AMERICANS ASSUME THAT EVEN VERY young children must learn to use computers to guarantee their future success in school and work. In fact, 30 years of research on educational technology has produced almost no evidence of a clear link between using computers in the early grades and improved learning. (One notable exception concerns children with certain disabilities, who have made significant gains with the help of assistive technology.) In spite of the lack of evidence of any real need for them, computers are becoming ubiquitous in U.S. primary schools.

The rush to computerize elementary education is at odds with much of what research in human biology and psychology reveals about children’s intellectual, emotional, social, physical, and spiritual needs. Nature has choreographed a carefully timed sequence of human development, marked by long periods of gradual progress and occasional spurts of growth. Each child’s experiences and particular variations to the common patterns of growth interact to form the child’s unique human

identity. This duet of experience and biology nurtures and integrates a wide range of capacities into the synergistic whole that makes us human beings, uniquely capable of learning, adapting, and maturing throughout our lifetimes.

To put it simply, childhood is our species’ evolutionary edge. Childhood takes time. And many children are simply not being given the time to be children.

Computers are perhaps the most acute symptom of the rush to end childhood. The national drive to computerize schools, from kindergarten on up, emphasizes only one of many human capacities, one that naturally develops quite late — analytic, abstract thinking — and aims to jump start it prematurely.

Seymour Papert, co-founder of the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology, has been particularly influential in promoting the use of computers by young children. But such an emphasis seems designed for training children to think in ways that appear more mechanistic than childlike.

* This chapter draws extensively on two recent books that thoroughly document the hazards that computers pose to the education of young children: *Failure to Connect: How Computers Affect Our Children’s Minds — for Better and Worse* by Jane Healy; and *The Child and the Machine: How Computers Put Our Children’s Education at Risk* by Alison Armstrong and Charles Casement.

For example, Papert himself, referring to Logo, the programming language for children he created, has said:

I have invented ways to take educational advantage of the opportunities to master the art of *deliberately* thinking like a computer, according, for example, to the stereotype of a computer program that proceeds in a step-by-step, literal, mechanical fashion . . . By deliberately learning to imitate mechanical thinking the learner becomes able to articulate what mechanical thinking is and what it is not. ¹

But can young children really differentiate between their own human thinking and the powerful operations of a machine? Is it even fair to impose such a task upon them?

Computers are the most sophisticated thinking tools ever designed. They were developed with adult bodies, as well as adult mental capacities, in mind. Even for adults, their intensive use is related to job stress and serious injuries. But emphasizing computers for children, whose growing bodies are generally more vulnerable to stress, presents several challenges to healthy development. The current focus on computers can distract schools and families from attending to children's true needs, and can exacerbate existing problems.

Hazards to Children's Physical Health

Emphasizing the use of computers in childhood can place children at increased risk for repetitive stress injuries, visual strain, obesity, and other unhealthy consequences of a sedentary lifestyle. Some development experts also warn that increasing the time that children spend on computers, given the hours they already sit in front of televisions and video games, may contribute to developmental delays

in children's ability to coordinate sensory impressions and movement and to make sense of the results. That could in turn lead to language delays and other learning problems.²

There are also potential but unproved health risks of toxic emissions from new computer equipment and exposure to electromagnetic radiation, especially from the old video display monitors that are still in use in many schools.

These health risks to children demand immediate action. But no one pushing the computer agenda — neither high-tech companies, nor the federal government, nor school officials — has yet publicly acknowledged the hazards, let alone taken action to remedy them.

Musculoskeletal injuries

Long hours at a keyboard, constantly repeating a few fine hand movements, may overtax children's hands, wrists, arms, and neck. That, in turn, may stress their developing muscles, bones, tendons, and nerves. For years, health and safety experts in government and industry have been recommending that adults who work at video display terminals take precautions to prevent such injuries: adjustable office furniture; changes in posture and careful attention to the angles of one's legs, arms, and neck while working; warm-up stretches; and frequent breaks from using a keyboard and mouse or staring at a screen. The American Occupational Therapy Association recommends a ten-minute break every hour.³

Alison Armstrong and Charles Casement explain why proper ergonomic design and frequent breaks are essential — especially for children:

However flexible it may be as a means of accessing and manipulating information, for

the user the computer is a kind of straitjacket into which the body must adapt itself. The eyes stare at an unvarying focal length, drifting back and forth across the screen. Fingers move rapidly across the keyboard or are poised, waiting to strike. The head sits atop the spine balanced, in the words of one physician, like a bowling ball. Built for motion, the human body does not respond well to sitting nearly immobile for hours at a time.⁴

The U.S. National Institute for Occupational Safety and Health, in a major research review in 1997, concluded that awkward postures and highly repetitive motions are strong risk factors for musculoskeletal injuries related to work.⁵ Such injuries can be both painful and serious. The median number of lost workdays for employees suffering from carpal tunnel syndrome, for example, is 25 days per year.⁶

Only a handful of studies have been conducted on the potential for musculoskeletal injuries for children using computers. But the results have been disturbing. They indicate that most schools are allowing children to use desktop or laptop computers in ways that put them at risk of straining their bodies and eyes.

College health clinics report high numbers of students complaining of computer-related pain. Many, including Harvard University and the Massachusetts Institute of Technology, have special Websites to advise students on prevention and how to seek help if they are injured. At M.I.T. about 175 students a year seek treatment for computer-related injuries, according to Dr. David Diamond of the university's medical center. A few are so injured they have to change their career plans, he adds.⁷

For Brendan Connell and his family in Silver

Spring, Maryland, the pain and the life changes that such injuries lead to are all too familiar.

Brendan is a 20-year-old Harvard student who started using computers in school at about age six. By high school he was spending hours each day at the computer, and started experiencing pain in his hands. Before the end of senior year, his injury was so severe that he could no longer write or type, and eventually had trouble even opening doors. With treatment, the pain is now less, but he is not completely healed. He says

that he has just about given up the idea of becoming a computer programmer because of the keyboard time that would require.⁸

Schools should get serious about ergonomic issues now,

says Dr. Margit Bleecker, a neurologist and director of the Center for Occupational and Environmental Neurology in Baltimore, who has treated Brendan Connell. "We know that these things can happen with children," she says, based on the reports of children who injure their hands playing video games. She expects the incidence of repetitive stress injuries in childhood to rise. "It's probably a time bomb waiting to go off."⁹

As younger children begin using computers intensively they may be at even greater risk of injury than older children are, some experts suggest. That's because their bones, tendons, nerves, muscles, joints, and soft tissues are still growing. A few reports of students developing repetitive stress injuries have begun to appear in the news media.¹⁰ But the full scope of this potential problem may not become known for years. Repetitive stress injuries, such as carpal tunnel syndrome, can be caused by the cumulative impact of years of repeated minor trauma.

Childhood repetitive strain injuries: "It's probably a time bomb waiting to go off."

—DR. MARGIT BLEECKER

For the most part, schools are in a state of denial about this issue. A team of researchers at Cornell University studied computer work stations for children in grades three, four, and five at 11 elementary schools. They found “striking misfits” at every school between the work stations and the children using them, resulting in unhealthy typing postures. In every school, the keyboards were set up too high for the children using them, and the computer monitors were also too high in most cases. The researchers concluded that at least 40 percent of the children were at risk of serious injury.¹¹

When repetitive injuries do occur, medical experts emphasize that prompt treatment, changes in work habits, and correction of computer-station ergonomics are essential to prevent chronic conditions. The latter may require expensive surgery, or long periods of recovery during which the simplest daily activities, such as buttoning a shirt or twisting a cap off a tube of toothpaste, can be painful or impossible. Left untreated, musculoskeletal injuries can even be permanently disabling.¹²

Alan Hedge, professor of ergonomics at Cornell University, helped supervise the study cited above, whose results were published in 1998. It appears to be one of the first American studies of childhood ergonomic issues related to computers. Hedge notes that recent studies in Australia indicate that children who use laptops instead of desktop computers appear to be at higher risk of musculoskeletal problems.

One 1998 study, for example, with 314 children aged 10 to 17, found that 60 percent of them reported discomfort in using their laptops. (Sixty-one percent also reported discomfort in just carrying their laptops. This calls into further question the wisdom of proposals to give all children laptops to carry

with them wherever they go.) The children who had used computers for the most years reported more discomfort than children who had been using laptops for only a few months. On average, the children in the study reported spending a total of more than 3.2 hours a day at their laptop keyboards, and 16.9 hours per week. The researchers concluded that “school children are exposing themselves to prolonged poor postures with laptop use that is leading to discomfort. This is of particular concern as it occurs during critical periods of their skeletal growth.”¹³

Keyboard and monitor are nearly always attached on a laptop. So it’s almost impossible to follow the guidelines for healthy posture when using them. Either the monitor is too low, causing neck strain, or the keyboard too high for healthy arm, wrist, and hand posture.

Hedge recommends that children take a break from computer work every 20 minutes and spend no more than about 45 minutes in any hour at a computer, and avoid spending more than 4 hours a day at computers and video games — including time spent both at home and school.¹⁴ A Roper Starch survey in 1999 estimated that the average American child is now spending about one to three hours every day at a computer. Hedge points to this figure as evidence of “great potential for injury.”¹⁵

Who will take financial responsibility for the care of children who do suffer injuries? For the millions of poor children whose parents do not have health insurance, this question is particularly salient. Families without health insurance are more likely to delay seeking treatment for health problems that do not seem serious. Headaches and occasional pain in the back, neck, or shoulders, for example, might seem like minor problems, but may actually be

an early warning that a child is at risk of more serious injuries ahead.

Vision problems

Computer use places added strain on a child's eyes and developing visual system, and may actually make learning to read more of a challenge for young children.¹⁶ Adult workers who use visual display terminals (VDTs) frequently complain of fatigue, eye strain, burning, tearing, soreness, blurred vision, and headaches.¹⁷ Eye strain experienced by computer operators is related to screen glare and to the screen being either too bright or too dim compared to the ambient light. Maintaining a constant focus on the same distance, at the same angle, inhibits blinking even more than does reading from a book, probably because the monitor presents a vertical reading surface and because our eyes are open wider, making it more of an effort to blink.¹⁸

Children, too, are at risk of visual fatigue from long spells at a computer screen, for all of the same reasons. But the immaturity of their visual systems raises some additional concerns. Infants and toddlers develop their visual-spatial awareness first through gross movements in space, such as crawling, and then by gradually fine-tuning their hand-eye coordination, until their eyes become adept not only at following their hands, but at leading their hands in finer and finer motions. Finally, after many integrated experiences of seeing, touching, and moving their hands and the rest of their bodies in three-dimensional space, young children develop an appreciation of visual forms as real objects, and the capacity to visualize objects without actually seeing

them. Too much time spent in passively looking at two-dimensional representations of objects on a computer screen — or a television set — may interfere with this developing capacity.¹⁹

Children's basic visual skills are generally well-established enough by the age of 6 or 7 —

that is, by first or second grade for most children — for them to comfortably focus on the kind of large two-dimensional representations of letters that teachers might draw on a classroom blackboard.

Behavioral optometrists recommend that children of this age learn about letters first

through direct physical engagement with them — perhaps by drawing or painting the letters as big as possible. This takes advantage of the deep perceptual learning that coordinating vision with gross motor skill encourages.

Expecting beginning writers to poke a letter key and then passively watch a letter appear on a screen can be hard on their eyes and an extra perceptual challenge, and thus may actually hamper the process of learning to write and read.

Grade-school children need even more frequent breaks from close computer work than adults do. That's because their muscular and nervous systems are still developing. It's not until about the age of 11 or 12 that their capacity to balance and coordinate the movement and the focusing of both eyes together is fully mature. Dr. Edward C. Godnig, a behavioral optometrist and author of *Computers and Visual Stress: Staying Healthy*, warns that intense computer use without proper breaks may delay the completion of that maturation into adulthood.²⁰

Eye experts also note that it can be difficult

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to achieve the proper lighting and ergonomic conditions in the average classroom to protect children from straining their eyes. To reduce glare, the fluorescent lighting of many classrooms would need to be dimmed by at least half. But to read books or to write on paper in the same room, the lighting ideally would be at the higher level. Closing window blinds is another way to cut down on glare. But one recent study on classroom lighting found a clear correlation between the amount of natural lighting from the sun and student achievement on tests of math and reading. The authors of that study surmise that sunlight may have a positive effect on eyesight, health, or mood for students and teachers.²¹

Eye experts suggest that children maintain a distance of about two feet from the monitor to avoid visual fatigue.²² But many children tend to lean as close as possible to the screen. This is a common, involuntary reaction that helps the learner literally “screen out” her peripheral vision, so as not to be distracted from the monitor. Also, ideally, children should be looking slightly down at the screen, at an angle of about 20 degrees, which research indicates is the most comfortable alignment of the eyes, the neck, and shoulders.

“Computers are adult-sized tools and children are having to adapt to them,” says Dr. Jeffrey Anshel, a behavioral optometrist in Carlsbad, California, and an expert on computer-related vision problems. “So they’re looking up at the screen, often at an awkward angle, for too long, and too close to it.” Anshel adds that in his own practice he sees children suffering the “same type of near-point stress that adults do,” and that they are developing near-sightedness at earlier ages than in the past.²³

Some optometrists suggest that the rate of myopia, or near-sightedness, in childhood will increase as children are encouraged to use computers for long stretches at home and school.²⁴ And some say they are already seeing such an increase in their practice. Although myopia is often related to genetic factors, research suggests that it can also be environmentally induced, particularly by chronic conditions of close visual work.²⁵

A pair of glasses may correct the immediate problem. But myopia itself may be a risk factor for other visual problems. It can interfere with children’s sports activities and enjoyment of nature, and even limit their choice of career. Some studies have suggested that myopia may have a broader psychological impact — that myopic individuals may tend to be more introverted and to pay more attention to detail, instead of taking a more global, long-range point of view.²⁶

Finally, some developmental optometrists suggest that Internet research, which involves scanning or reading long documents for meaning, requires the kind of visual skills and perceptual abilities that are generally not well-developed until about the age of 9, which would mean fourth grade, for many children. It also, of course, requires a child to be an accomplished reader.²⁷

Eye experts agree that reading a book or printed page is less of a strain on the eyes than reading from a computer screen. Even Bill Gates of Microsoft has admitted as much. “Reading off a screen,” said Gates in a speech, “is still vastly inferior to reading off of paper.... When it comes to something over four or five pages, I print it out and I like to have it to carry around with me and annotate.”²⁸

Chronic eye discomfort related to intense

computer work is likely to exact a toll on student achievement. Research shows that some people respond to eye strain by simply avoiding the task causing it.²⁹

Lack of exercise and obesity

Even before the recent push to computerize elementary education, obesity and other health problems related to children's increasing physical inactivity were on the rise. By 1994, the most recent year for which the federal government has statistics, nearly 14 percent of children in the U.S. ages 6 through 11 were overweight. In 1965, only 5 percent were. In 1994, an additional 20 percent weighed enough to be considered at risk of becoming obese.³⁰ Many health professionals believe childhood obesity has increased since 1994, in large part because children spend more time sitting in front of electronic media and less time actively playing, at home and school, and because they consume so many high-fat, high-sugar foods.³¹

"We have the most sedentary generation of young people in American history," warns U.S. Surgeon General David Satcher.³²

The rate of Type 2 diabetes, a serious, incurable disease associated with obesity and which in the past was rarely diagnosed in childhood, is also now rapidly increasing among children.³³ Pediatricians report treating extremely obese children for what are normally adult complications of excess weight, such as obstructive sleep apnea and fatty liver, a precursor to cirrhosis.³⁴ Children who grow up obese also are at higher risk of other chronic health problems as adults, such as high blood pressure and heart disease.³⁵ Recent studies also

suggest that at least some of the alarming rise in childhood asthma may be related to obesity, perhaps because lack of exercise may reduce the efficiency of a child's respiratory system.³⁶

Lack of exercise is bad for learning. Child development experts emphasize that moving in three-dimensional space stimulates both sensory and intellectual development. According to educational psychologist Jane Healy, research with physically disabled children suggests that those who are restricted in freely moving around and applying all of their senses to exploring the world are at higher risk of developmental delays in

We have the most sedentary generation of young people in American history.

— DAVID SATCHER,
U.S. SURGEON GENERAL

seemingly unrelated mental abilities, such as comprehending abstract verbal concepts. "As a child learns to put movements in order, brain areas are primed to put words and ideas into a logical sequence," Healy writes in *Failure to Connect*.³⁷

Increasing numbers of children are also being diagnosed with attention disorders. Some developmental specialists suspect that some of these children may be spending so much time sitting in front of televisions, video games, and other electronic media that their auditory and perceptual-motor skills are not up to the demands of classroom learning.³⁸

Other researchers have noted that the demands of moving about in the real world provide a foundation for more advanced intellectual capacities. As a *Scientific American* article put it: "Human intelligence first solves movement problems and only later graduates to pondering more abstract ones."³⁹ Through time, the developing nervous system seems to transform actual physical experiences into mental adeptness in manipulating, categorizing,

and comprehending abstract ideas. The artificial, two-dimensional environment of computer learning is no match for that.

Toxic emissions and electromagnetic radiation

The U.S. Environmental Protection Agency has identified 21 chemicals that are released in the vapors emitted by new computers and VDTs. The agency estimates that it can take from 144 to 360 hours for them to dissipate completely. In a 1995 report, the agency noted that “the implications of these emissions can be particularly significant in an indoor environment containing several new pieces of electronic equipment, e.g., a computer room in a school.”⁴⁰ Office workers exposed to these emissions have experienced skin problems and ear, nose, and throat irritations.

VDTs also produce electromagnetic fields, or EMFs. Whether this radiation is dangerous, especially at the relatively low levels that computer monitors generally emit, is a controversial subject among scientists. Some early studies suggested a link between childhood leukemia and exposure to electromagnetic fields for families living near high-current electric wires.

An expert panel of the National Research Council concluded that no convincing evidence exists that exposure to electromagnetic fields from power lines, VDTs, or other home appliances was a threat to human health. The committee based its 1996 report on a review of about 500 studies. It did find a weak but statistically significant link between the incidence of childhood leukemia and living close to high-power lines. But it added that the results of research trying to establish whether the magnetic fields from the wires were actually

implicated as a cause of the disease have been “inconsistent and contradictory.” It could be that the higher rate of childhood leukemia is related to some other factor common to homes near power lines, the group added, such as poor air quality or pollution from heavy traffic.

But the panel called for more research on that question. It also called for more research on the relationship between exposure to electromagnetic fields and breast cancer in animals that have been exposed to carcinogens, and on why EMFs seem to affect the levels of the important hormone melatonin in animals. The same effect has not been observed in human beings.

In 1999, the U.S. National Institute of Environmental Health Sciences recommended, after a lengthy review, that EMF exposure continue to be recognized as a “possible” cancer hazard. But it also stressed the weakness of the evidence and “the low risk that may be involved.”⁴¹

The release of radiation is highest from the backs and sides of terminals, but many schools place them either front to back, or too close, side to side. That may expose children to radiation from the VDT being used by a nearby child.

To be on the safe side, schools should at least be testing their own VDTs regularly and making sure that children sit some distance away from their own and others’ monitors, since the radiation dissipates over a short distance. For older monitors, built before the mid-1990s, three feet is generally considered a safe distance.⁴²

For years, the federal government has been warning private employers and employees about the physical health hazards of using computers intensively.⁴³ But it has done little to alert schools, teachers, or parents of the hazards for

children, though it encourages the use of computers from kindergarten on up. In fact, the Department of Education has never conducted any studies of whether children using computers are at increased risk of repetitive stress injuries, or how to prevent such injuries, according to Carol Wacey, deputy director of the agency's Office of Educational Technology.⁴⁴

All of these negative physical effects of children spending increasing amounts of time sitting at computers are among the most obvious hazards that computers pose to children's healthy development. Because they are so obvious, so serious, and yet still so widely ignored, they are also the most troubling.

Children are captive audiences in the classroom. Unlike responsible businesses, however, few schools now have in place the kinds of health and safety precautions that would at least try to minimize the chances of computer injuries.

The Alliance for Childhood urges every parent, teacher, and policymaker to take immediate action to ensure that no child is subjected to work stations at school that are not ergonomically designed and adjustable for each student's height and size. If schools insist on requiring young children to use computers, they have a responsibility to take such precautions — and to share the legal liability for injuries if they do not. They also should provide the training and supervision that would be required to try to prevent children from straining their eyes or bodies in unhealthy ways at computer stations.

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Ironically, the U.S. National Institutes of Health, in a labor agreement covering all employees who routinely use VDTs, specifically acknowledges the dangers:

...there are certain ergonomic and environmental factors that can contribute to the health, safety, and comfort of VDT users.

These factors involve the proper design of work stations and the education of managers, supervisors, and employees about the ergonomic, job design, and organizational solutions to VDT problems as recommended in various studies on VDT usage. The Agency agrees that employees should be provided information about ergonomic hazards and how to prevent ergonomically-related injuries... It is also agreed that when equipment is purchased, to the extent possible, training

should be provided by the vendor on how to safely and properly operate the equipment.⁴⁵

It's appropriate, of course, for the government to so warn its own employees. But who will take official responsibility for warning teachers and children?

One reason why schools have not confronted this problem is that correcting it may be practically impossible. In any one class, there is a wide range of heights and sizes among students, and individual children grow unpredictably over the year. Purchasing and setting up equipment to accommodate these differences, and trying to train young children to adjust their posture and to continually readjust the chairs and keyboards they share with others would be a massive and perhaps futile effort. In fact, adjustable child-size

furniture is not widely available or affordable at this time. Cornell University's Website with recommendations for schools notes that adjustable furniture is often difficult even for adults to operate. It adds that young children may not yet be aware of how their bodies are oriented in space, so expecting them to maintain correct posture without constant reminders might not be reasonable.⁴⁶

Risks to Emotional and Social Development

Child-development experts like Dr. Stanley

I. Greenspan, the former director of the Clinical Infant Development Program at the National Institute of Mental Health, warn that an emphasis on computers in childhood exacerbates the tendency for our increasingly rushed and impersonal culture to harm the emotional development of children. And that, they add, will take a toll on their intellectual, social, and moral development as well, because emotions guide human learning and behavior.

“So-called interactive, computer-based instruction that does not provide true interaction but merely a mechanistic response to the student's efforts,” says Greenspan, is one more sign of “the increasingly impersonal quality that suffuses the experience of more and more American children.” As children at all income levels grow up with less nurturing at home and school, he adds, “we can expect to see increasing levels of violence and extremism and less collaboration and empathy.”⁴⁷

The most important gift that parents can give a child to spur their mental development, Greenspan adds, “is not a good education,

elaborate educational toys, or summer camp, but time — regular, substantial chunks of it spent together doing things that are naturally appealing to the child.” A single parent, for example, “could consider leaving the television or computer off and recruiting a little interactive partner or partners in daily routines of cleaning, cooking, and shopping.”⁴⁸

'Isolated lives'

But by 1997, parents were already spending about 40 percent less time with their children than they had 30 years before.⁴⁹ With the

recent surge in the purchase of home computers, laptops, and home connections to the Internet, as well as school connections, children are likely to spend even less time interacting face-to-face with parents, teachers, and friends. A 1999 study by the Kaiser Family

Foundation concluded that children ages 2 to 18 spend on average about 4 hours and 45 minutes a day outside of school plugged into electronic media of all kinds. About 65 percent of the older children, ages 8 to 18, had televisions in their bedrooms, and 21 percent had personal computers.⁵⁰

Another recent study estimated that children between the ages of 10 and 17 today will experience nearly one-third fewer face-to-face encounters with other people throughout their lifetimes as a result of their increasingly electronic culture, at home and school.⁵¹

“Kids are living much more isolated lives than ever before,” Kay S. Hymowitz, author of *Ready or Not: Why Treating Children as Small Adults Endangers Their Future — and Ours*, told *U.S. News & World Report*. “They just

Children ages 2 to 18 spend on average about 4 hours and 45 minutes a day outside of school plugged into electronic media of all kinds.

disappear into their rooms and spend all of their time with [these] media.”⁵²

Developmental experts say the intense challenges of face-to-face interactions offer children the most emotionally maturing experiences. But even when teachers and students are together in the classroom, they may be distracted from each other by the powerful new information technologies in their midst.

Proponents of computers in schools argue that they shift the classroom focus to the student instead of the teacher, whose traditional role they describe as the ineffective “sage on the stage.” In the high-tech classroom, they suggest, the teacher becomes “guide on the side,” encouraging students to take charge of constructing their own education. The result is supposed to be “student-centered” education.

The new sage on the stage

But the ubiquitous pictures in the news media of both students and teachers concentrating intently on a computer screen — instead of each other — clearly illustrates a new sage dominating center stage. The actual shift is to computer-centered, not student-centered, education.

“Nearly half of the staff development courses are now basic computer training,” observed Lowell Monke in 1997, speaking of the Des Moines (Iowa) Public Schools, where he was then teaching advanced technology classes. “As I listen to teachers and administrators discussing educational issues now, as opposed to three years ago, I hear much less attention directed toward what is going on inside our students, and much more toward what goes on with the tools they use.”⁵³

The essence of education is neither the teacher, the students, nor the subject of study

alone, but rather the liveliness of the relationship among the three. Students are inspired to learn by the enthusiasm of a teacher they respect — the teacher’s enthusiasm, that is, for both the students themselves and the world the teacher is introducing to them.⁵⁴

Research by the Israeli psychologist Reuven Feuerstein on Down syndrome, for example, indicates that even children with severe learning problems can make surprising educational progress when they have an attentive teacher who consciously, consistently, and imaginatively finds ways to directly mediate between the child and the world. The teacher serves as the ideal model for the child of an engaged, competent learner. She also helps the child translate the world’s meaning — moral and emotional meaning as well as intellectual — into the child’s own words, so to speak. Only a human being, not a machine, can model this uniquely human kind of learning.⁵⁵

Grade-school teachers, the majority of whom are women, are the real classroom experts with both the training and the commitment to work personally with children. Today, however, they often face intense pressure from supervisors or technology coordinators, who are frequently men, to incorporate computers into the curriculum. The teachers themselves often judge the technology to be not particularly beneficial for their young students. Little research has been done to uncover the role of gender in the politics of educational technology or the impact of this pressure on schools’ ability to retain strong teachers.

There is anecdotal evidence, however, that teachers are being pressured—or even coerced—into implementing high-tech solutions that may run counter to their own professional judgment.

The male technology coordinator at one inner-city school in Washington, D.C., for example, candidly conceded to an outside observer that teachers who were not enthusiastic about his school's new high-tech approach to learning had been encouraged to retire or seek transfers to other schools, and that several had done so. He volunteered that he was considering encouraging the principal to get rid of one remaining kindergarten teacher, solely because he believed the children in her class did not spend enough time on computers.⁵⁶

Given the dazzling graphics and animations of the latest software — which may be highly entertaining without being particularly educational — and the daily challenge of keeping so much sophisticated equipment up and running, and frequently updated, how could attention not shift to the machines in the classroom?

Less self-motivation

Computers are invariably said to be highly motivating to students. But those who make this assertion rarely provide specific evidence for their claim. They rarely attempt to quantify the presumed increase in motivation, or to determine whether girls and boys are equally enthusiastic about the new technical overlay to every subject of study. They rarely offer evidence of how this supposed boost in motivation has led to any deeper or broader learning. Nor do they examine whether any number of other educational techniques—using artistic activities to bring the subject alive, for example—might not have boosted motivation in less expensive and more age-appropriate ways.

A recent study by the American Association of University Women Educational Foundation challenges the notion that computers routinely

motivate classroom learning. Many girls, it found, are bored by computers. And many boys seem more interested in violent video games than educational software.⁵⁷

Other researchers have suggested that young students often seem to be mesmerized by, and some even addicted to, the action on their screens, rather than motivated to learn. A fascination with technology, they caution, is not the same thing as a motivation to learn about educational subjects beyond the technology itself. Even some software producers admit that the most mesmerizing educational software may be more entertaining than educational.⁵⁸

On the other hand, some studies have indicated that any initial academic gain generated by bringing computers into the classroom may dissipate as the novelty of the technology wears off for both students and teachers. To some extent, this would seem to be a matter of common sense. Eventually, students tend to become just as jaded about surfing the Internet as anything else, say experienced teachers.⁵⁹

Research indicates that the most troubled schools can improve the educational performance of their students by strengthening teacher-student bonds and making other, people-oriented changes to foster a strong sense of community.⁶⁰ But the huge costs of purchasing, maintaining, and constantly updating computers and training teachers and students to use them has made it difficult for schools to hire additional, qualified teachers to reduce class size and to give the most disadvantaged and challenging students the personal attention they need.

Researchers often hypothesize that the shared excitement generated by new technologies in the classroom can itself boost the sense of

community at the classroom and school level, and encourage student collaborations and faculty exchanges. The evidence for how lasting or how much related to learning such effects really are, however, is thin. Much of the research is sponsored by high-tech companies, and the reports of results rarely provide objective measures to prove the sweeping conclusions researchers draw about the positive effects of computers on student collaboration and motivation. Yet federal officials and others frequently cite such work as proof of technology's benefits. Meanwhile, educators have noted that computer-aided collaboration may spark classroom conflict as well as cooperation.

Detachment from community

Instead of boosting the sense of community, highly computerized schools may actually weaken it, especially as Internet and e-mail options proliferate. Few researchers have investigated this possibility. But a special report published by the U.S. National Science Board in 1998 included an unusual federal admission that prolonged exposure to a computing environment may harm children's emotional and psychological development in ways that would hardly build strong communities. Citing the work of Sherry Turkle, professor of sociology at M.I.T., the report stated: "Computing and cyberspace may blur children's ability to separate the living from the inanimate, contribute to escapism and emotional detachment, stunt the development of a sense of personal security, and create a hyper-fluid sense of identity."

The Science Board panel added: "Turkle raises the possibility that extensive interaction with cyberspace (especially through multi-user domains) may create individuals incapable of

dealing with the messiness of reality, the needs of community building, and the demands of personal commitments."⁶¹

The commercialization of childhood

The emphasis on connecting every child to the Internet raises a host of issues related to exposing children to a flood of commercial messages promoting everything from candy and electronic toys to pornography, violence, drugs, and race hatred.

As one school librarian in Greenville, South Carolina told her local newspaper, "It doesn't matter if you put 100 software filters on there. You can still get around them if you want to."⁶²

She was speaking of pornography. But commercialism is even more difficult to escape. Many companies now intentionally direct a barrage of commercial messages at young children on the Internet. Sites designed to captivate young children often promote early sexual behavior, sugary foods, and a limitless craving for new products.

"Generation X is going to give way to Generation Excess," warns Betsy Taylor, executive director of the nonprofit Center for a New American Dream, which opposes the commercialization of childhood.⁶³

The Website of MaMaMedia.com, for example, promotes itself as presenting "playful learning" activities aimed at children 12 and under, based on extensive research at Harvard and M.I.T. The co-founder of M.I.T.'s prestigious Media Lab is listed as chairman of MaMaMedia's advisory board.⁶⁴ The site also features the names of its commercial sponsors — which include the producers of high-sugar drinks and foods and video games. The site links children to one advertiser's new release, "X-Men Mutant Academy," which will allow

young children to “Brawl your way around the world, one opponent at a time.”⁶⁵ It also links children to the Websites of a long list of candy companies. On one link children are able to download a screensaver of Hershey’s Miniatures “stacking up before your eyes,” or “Flying Reese’s Peanut Butter Cups,” thereby setting up their own background ad for a chocolate break.

The high cost of technology is leading some schools to make deals with companies that provide free or leased computer equipment and telecommunications services in exchange for online advertising opportunities. Even SesameStreet.com, which caters to preschoolers, makes available to advertisers “a variety of ad models from targeted banner campaigns to premium sponsorships.”⁶⁶

Marketing consultants like Roper Starch Worldwide now survey children ages 6 to 17 about their “hopes and dreams ... their daily lives, what they love and hate on TV and why, what they buy and why they buy it, what they do online.” Why should companies be interested in buying this information? Because this generation is the largest ever, representing “the supreme opportunity to today’s marketers of youth products.”⁶⁷

Another site, iCanBuy.com, was created to let children of all ages shop directly over the Internet by first setting up accounts that draw on their parents’ credit cards, with parents’ permission. The site, in a nod to moral rectitude, also includes a page from which children can direct donations to their favorite charities. Here, former Spice Girl Geri Halliwell promises to reward them for such altruistic behavior with a “free gift with every donation you make!” The more children contribute, the more free autographed products they get. And, by the way, children can also point and click on

the same page to purchase Geri’s new CD. The message to young children could not be clearer — never give anything without first making sure exactly what you will get in return.⁶⁸

Some responsible proponents of Internet learning suggest that “media education” — lessons in how to appraise critically the biases and subtle messages promoted by the media — will protect children from such commercialism. Teen-agers would surely benefit from such a direct appeal to the kind of logical, abstract reasoning that such critiques require. But what of five-year-olds, for whom abstract reasoning is not a realistic expectation? And must we train every young idealist to be a cultural skeptic, or worse, a jaded cynic?

Few adults are capable of resisting, day in and day out, the relentless, sophisticated marketing ploys that some of America’s most creative minds have designed, aided by professional psychologists and anthropologists paid to advise corporations on how to manipulate consumer behavior. What then of children, who are now the targets of intense consumer research? To be a child, after all, is to have the right to be immature and to need adult guidance and adult protection.

It is neither fair nor realistic to expect young children to be intellectually, emotionally, and morally mature enough to exercise advanced critical thinking skills in the face of commercials scientifically calibrated to target their most vulnerable emotions.

The American Academy of Pediatrics, in a policy statement on children and advertising, notes that the ancient Code of Hammurabi “made it a crime, punishable by death, to sell anything to a child without first obtaining a power of attorney.” It also reports on “numerous studies documenting that young

children under 8 years of age developmentally are unable to understand the intent of advertisements and, in fact, accept advertising claims as true.” Its conclusion is blunt: “The American Academy of Pediatrics believes advertising directed toward children is inherently deceptive and exploits children under age 8 years of age.”⁶⁹

And what of older children? They do not suddenly become fully capable of critical judgment at the age of 9. In fact, the adult content and come-ons so common on the Internet are a powerful illustration of why it is inappropriate for children.

“Having the Internet in the classroom,” one commentator has said, “is like equipping each classroom with a television that can be turned on at any time and tuned in to any of 100,000 unrestricted channels, only a tiny fraction of which are dedicated to educational programming (and even those have commercials). The Internet isn’t about education. It’s about marketing.”⁷⁰

Risks to Creativity and Intellectual Development

Computers, which are supposed to accelerate the pace of children’s cognitive development, reflect the same mechanistic approach to education as a narrow focus on raising standardized test scores. Because all aspects of children’s growth are so well integrated, however, the concentration on cognitive skills, narrowly conceived, actually can backfire. Failing to meet children’s emotional and physical needs, as discussed above, can take a toll on academic learning as well.

But even as tools narrowly focused on cognitive development, computers do not appear to be a promising technology for elementary education. Their sheer power seems more likely to repress the development of important intellectual capacities than to enhance it.

Stunted imagination

Creativity and imagination, for example, are critical to intellectual insights and sophisticated problem-solving in just about every academic domain. Creative work draws on a child’s own

inner resources — including originality, playfulness in generating ideas, and vigor and perseverance in carrying them out. Similarly, imagination involves the capacity to bring to life pictures of one’s own in one’s own mind.

Children who are exposed to a heavy electronic diet of television, the Internet, video games, and multimedia are bombarded with ready-made images, often cleverly animated and quickly swapped with a point and a click, literally leaving nothing to the imagination. Entertained constantly and effortlessly by so many adult-generated images, children seem to be finding it harder to generate their own images and ideas.

Educational psychologist Jane Healy, a former school principal, notes that creativity involves the ability to generate “personal and original visual, physical, or auditory images – ‘mind-images’ in the words of one child.” But she adds: “Teachers find that today’s video-immersed children can’t form original pictures in their mind or develop an imaginative representation. Teachers of young children lament the fact that *many now have to be taught*

Teachers find that today’s video-immersed children can’t form original pictures in their mind or develop an imaginative representation.

—JANE HEALY,
EDUCATIONAL PSYCHOLOGIST

to play symbolically or pretend— previously a symptom only of mentally or emotionally disordered youngsters.”⁷¹

Some scientists suggest that popular simulation programs that many schools are using to teach biology and other subjects will dampen the natural, open-ended curiosity and creativity of children. They may lead students to passively accept that the programmed constraints of the simulations neatly capture what is actually a far more complex and less predictable reality. One physicist put it this way: “My concern is that we are tending to expose students to too many contrived, controlled versions of reality rather than nature as its raw, untidy self. If our schools’ curricula included an hour of birdwatching or rock collecting, or fossil hunting or astronomical observing for every hour spent in virtual reality, I could be content, but increasingly that seems not to be the case.”⁷²

Software designers often limit their own attempts to be imaginative to clever animations that draw heavily on fantasy. For grade-school children, however, imagination is a much broader quality, a powerful technique that they naturally tend to use at this age to grasp “from the inside” the real qualities of the world they are exploring. They apprehend the world with their imaginations, which requires that they form their own internal images. By encouraging children in grade school to think in as clear and emotionally compelling pictures as possible, adults help them lay a solid foundation, based in material reality, for later mastery of more advanced forms of thinking. The latter entails logical abstractions, such as conscious considerations of cause and effect.

Douglas Sloan, professor of history and education at Teachers College of Columbia

University, has asked: “What is the effect of the flat, two-dimensional, visual, and externally supplied image, and of the lifeless though florid colors of the viewing screen, on the development of the young child’s own inner capacity to bring to birth living, mobile images of his own?”⁷³

So the issues of creativity and imagination are crucial in elementary education. Unfortunately, like many other questions about the negative impact of computers in childhood, almost no research has been conducted on the potential for computers to stifle children’s creativity and imagination. The results of the only well-known study on creativity, however, are not reassuring. It found that preschool children scored significantly lower on measures of creativity after using a popular software package designed to teach reading.⁷⁴

In one sense, at least, teachers themselves are under pressure to be less creative in the classroom. Once they were rewarded for bringing a lesson alive by using, or even recycling, the cheapest materials available in creative ways. Teachers and parents alike encouraged children to be resourceful in using simple materials like crayons, cardboard, and string. Instead, teachers now are often expected to narrow their vision to lesson plans that must incorporate the most expensive equipment available.

Similarly, children’s work is now too often judged to be an “authentic product” only if it mimics the slick commercial presentations that adults produce in high-tech offices with computer-generated art, spreadsheets, videos, word-processing, PowerPoint presentations, and other sophisticated software. This devalues children’s hand-drawn artwork. Proponents of such narrowly defined “authenticity” even suggest that the technical polish of such

“products” makes schoolwork “seem real and important.”⁷⁵ This emphasis on glossy production values seems calculated to distract both teachers and students from the curricular content and developmental goals that were the point of the project. Instead, the emphasis becomes mastery of technical skills that children don’t really need and that will soon be obsolete in the workplace anyway.

Loss of wonder

Computer use may also undermine the sense of wonder and reverence that young children typically bring to their encounters with the real world of rocks, bugs, and stargazing. Such wonder, especially if parents and teachers share in it, can powerfully motivate young learners in the healthiest way possible.

When preserved throughout childhood, this reverence for the beauty and goodness of life can also inspire older students to feel a devotion to truth, one of the most powerful motivations for more mature intellectual work. And young adults, with these healthy capacities intact, are likely to be motivated to transform what they have learned into a resource for their own moral deeds in service to the world.

Without these capacities, it’s tempting to treat knowledge as a collection of useful facts and figures that an individual — or even an entire culture — can exploit solely for one’s own entertainment or private gain. In short, a child’s wonder may later bear fruit in the adult’s sense of responsibility for his community and for the larger ecosystems that sustain human life itself.⁷⁶

How does an intense focus on learning about nature and every other aspect of the world through a computer screen affect a child’s sense of wonder? It would be difficult to

design a study to answer that question. But like other profound questions about how computers are changing children’s inner lives, it is too important to ignore.

What happens to the capacity for quiet wonder, for example, when children are regularly bombarded with cartoonish graphics that are far louder and flashier than the real thing, or sanitized, edited versions of reality that don’t give them a chance to get their hands dirty? When laptops and other electronic paraphernalia become necessary gear, interfering with a direct experience of nature, on those rare occasions when children are allowed to venture out into the real world? And when children are required to reduce their encounters with nature, often imaginative and emotionally rich experiences in their own right, into data to feed into slick, computer-generated charts and graphs?

Impaired language and literacy

Language and literacy skills are another area of concern when children are on a high daily dose of electronic media. Supportive social interactions with more competent language users is “the one constant factor that emerges” in studies of how children become able speakers, readers, and writers, research psychologists Alison Garton and Chris Pratt concluded after an extensive review of the literature.⁷⁷

But the time spent with computers and other electronic media may distract both children and adults from directly communicating with one another, face to face, weaving together the rich variety of spoken and unspoken cues such interactions encourage. That, literacy experts warn, may place children at risk of language delays. In addition, too few chances for such communication, if extended

throughout childhood, may permanently limit children's ability to express themselves in speech or in writing, to comprehend fully what they read, and even to understand themselves and to think logically and analytically.⁷⁸

All of these capacities are rooted in language. Progress in each domain, in turn, enriches a student's language skills. Research charting literacy development has shown that those skills are still very much being developed after children enter school.

"Although we marvel at the magnitude of children's language use at the point of school entry, as clearly as they have learned a great deal about language in a relatively short period of time, they still have a great deal more to learn," Garton and Pratt note. "The years from 5 onwards must be regarded as a time when language skills are consolidated and expanded."⁷⁹

With children spending more time alone with TVs and computers instead of interacting with others, they come to school in need of more, not less, spoken conversation with responsive adults. Is it wise for schools to exchange face-to-face time with teachers for hypertext and hypermedia?

So-called "interactive" software designed to monitor students' performance, correct their errors, modify the pace of lessons accordingly, and even give them programmed encouragement to keep trying obviously can't substitute for the dynamic exchanges, verbal and nonverbal, that a teacher who knows and loves her students can initiate. Literacy is a social enterprise that is threatened when children's social interactions are impoverished.

Barry Sanders, professor of English and the history of ideas at Pitzer College, warns of this in his 1994 book, *A Is for Ox: Violence, Electronic Media, and the Silencing of the Written Word*:

Every person or group of persons who move into literacy first build a foundation for reading and writing in the world of orality. Orality supports literacy, provides the impetus for shaping it. The skills one learns in orality are crucial because literacy is more than a series of words on paper. It is a set of relationships and structures, a dynamic system that one internalizes and maps back onto experience. A person's success in orality determines whether he or she will "take" to literacy.... But the way has been blocked. It has been blocked by electronic machinery of every conceivable kind, from TV and movies, through records and CDs, to PCs and video games. Before teachers and parents begin to think about raising literate children, they must first ensure their beings as creatures of orality.⁸⁰

Sanders adds that "good readers grow out of good reciters and good speakers."⁸¹ Then, as a child matures, his success in reading and writing nurtures his "innermost, intimate guide, the self."

So any threat to language and literacy may limit children's "inner voice" — their capacity to tell themselves stories and talk themselves through academic or other problems. "This inner speech," notes Jane Healy, "originates from talking with adult caregivers — and then having enough time and quiet space to practice it alone.... Inner speech is important to academic as well as personal development. From ages six to nine, gains in math achievement as well as in other subjects are related to the use of self-talk. ('How should I do this problem — oh, I think I'll try...') Delays in acquiring and using 'self-talk' may interfere with attention and behavior, as well as effective performance in sports."⁸²

Poor concentration

Healy and other experts suggest that many current uses of computers in schools may be encouraging unhealthy habits of mind. Success in school requires children to pay attention in a

focused way and to develop their memories and their listening skills. More children than ever before, however, are being diagnosed with attention disorders and placed on powerful drugs to help them concentrate. The multiple options of many software programs and the endless chain of links the Internet presents already make it tough for a child to keep her mind focused on a particular subject or task. And the need for children to take breaks from the computer every 20 minutes to avoid physical stress, as Hedge has recommended, seems likely to make it even harder for children to sustain their concentration.

Marilyn B. Benoit, president-elect of the American Academy of Child and Adolescent Psychiatry, has coined the term “dot.com kids” to describe the negative impact on children of being able to command so many entertaining images and messages with just a click of the mouse. Children’s brains, she suggests, are overstimulated by the pace and attention-grabbing nature of multimedia technology. She notes the rise in diagnoses of attention deficit hyperactivity disorder and asks whether it is related to “children’s constant exposure to rapid-fire stimuli to the brain.”

Little patience for hard work

Instant gratification, Benoit adds, may make it harder for children to tolerate frustration, which, in turn, may lead to episodes of explosive rage when they cannot have what they want, when they want it:

I am impressed by the apparent link between technology, instant gratification, poor frustration tolerance, lack of empathy, and aggression. While I do not propose that technology is the cause of the episodes of horrific violence we have seen in young people in recent years, I do

think that we should be mindful of some of the negative impacts of our technologies... I contend that the combination of decreased parental protection and increased instant gratification changes the psychology and undermines the socialization of the developing child. When frustration tolerance is not acquired, modulation and management of aggression is compromised, and we see children like those who are now labeled “explosive” children. Excluding those children with neurobiological deficits, psychiatry describes such children as “narcissistic” and their explosiveness as “narcissistic rage.” They are children who are unable to cope with the slightest of frustrations, and lash out aggressively. They are entitled, demanding, impatient, disrespectful of authority, often contemptuous of their peers, unempathic and easily “wounded.” Their numbers are increasing. We must take note of this disturbing trend and intervene with some urgency if we are to raise children who will care about others in society.⁸³

Jane Healy suggests that much educational software amounts to “electronically sugar-coated ‘learning’ that may spoil children’s appetite for the main course.” She adds:

Learning is, indeed, fun, but it is also hard work. In fact, working hard, surmounting challenges, and ultimately succeeding is what builds real motivation. Any gadget that turns this exciting and difficult process into an easy game is dishonest and cheats the child out of the joy of personal mastery. Encouraging children to “learn” by flitting about in a colorful multimedia world is a recipe for a disorganized and undisciplined mind....

Accessing or memorizing isolated information, or dabbling at an occasional skill sandwiched amidst an entire loaf of intellectual Wonder Bread, has nothing to do with true learning, which requires making meaningful connections between facts and ideas. Today’s children

are overpowered with data and special effects, but teachers report they have trouble following a logical train of thought or linking ideas together.

Finally, some of the “habits of mind” fostered by this software are dangerous, to wit: impulsivity, trial-and-error guessing over thoughtful problem-solving, disregard of consequences, and expectation of overly easy pleasure.⁸⁴

Plagiarism

Emphasizing Internet research makes plagiarism far more tempting to students. And the subtle shift in focus from their inner intellectual growth to how professionally they present computer-generated projects may make many students wonder what’s the difference if they plagiarize or not. As one high-school sophomore remarked after downloading an essay on healthy eating — in Spanish — from the Internet to fulfill a classroom assignment: “I didn’t think it was cheating because I didn’t even stop to think about it.”⁸⁵

And as a high school teacher in Wisconsin noted: “We’re somehow not able to convince [students] of the importance of the process. It’s the product that counts.”⁸⁶

Distraction from meaning

Jeffrey Kane, dean of education at the C. W. Post Campus of Long Island University, argues that teachers, parents, and children may be too dazzled by classroom information technologies to focus much at all on the child’s inner experience of meaning. He defines meaning as “a form of inner awakening in response to an encounter,” and tells the following story:

Recently, I visited a sixth-grade classroom where children were studying the Renaissance. They used the Internet to find information about the period. They prepared their reports

by using word processing and graphic programs, including video and audio components. The children proudly demonstrated their reports, and the teacher complimented their work by telling me that they knew more about the software used than did she. The reports contained a reasonable amount of information, the kind that would be available in any text, and they showed a great deal of effort in combining the various media.

However, I did not get the sense in talking with them that they internalized much of the drama and cultural richness of the Renaissance. They did not get a vivid picture of the lives of the painters, their motivations, pains, and imaginations. They did not acquire the compelling insights that would come from reading a book such as Giorgio Vasari’s *Lives of the Most Eminent Italian Painters, Sculptors, and Architects*, a collection of firsthand biographical sketches written during the Renaissance. The Internet and databases the children used were not conducive to reading such a book. From what I’ve seen in classrooms, the technologies used have almost no place for books at all. In this case, the children looked for information, got it, and moved on to the presentation. The teacher did not guide them further to experience some of the inner meaning of the period, of the unfolding of new aesthetic and intellectual capacities played out on the scale of individual lives. Rather than pursue the richness of the Renaissance as a foundation for new visions and insights within themselves and in the world, the children learned to use the software programs available. They learned more about how to think like computers than like the people of the Renaissance.

Although one may argue that the Internet and computer searches of various sorts could produce the information I describe, the fact remains that neither the teacher nor the students had any sense that something was

WARNING: Computers May Be Hazardous to A Child's Health

Emphasizing computers in childhood may expose children to the risk of a broad range of developmental setbacks. Potential hazards include the following:

Physical Hazards

- Musculoskeletal injuries
- Visual strain and myopia
- Obesity and other complications of a sedentary lifestyle
- Possible side effects from toxic emissions and electromagnetic radiation

Emotional and Social Hazards

- Social isolation
- Weakened bonds with teachers
- Lack of self-discipline and self-motivation
- Emotional detachment from community
- Commercial exploitation

Intellectual Hazards

- Lack of creativity
- Stunted imaginations
- Impoverished language and literacy skills
- Poor concentration, attention deficits
- Too little patience for the hard work of learning
- Plagiarism
- Distraction from meaning

Moral Hazards

- Exposure to online violence, pornography, bigotry, and other inappropriate material
- Emphasis on information devoid of ethical and moral context
- Lack of purpose and irresponsibility in seeking and applying knowledge

missing. The “lessons” reflected a fascination with technology, rather than with the capacities for human experience and vision identifying the Renaissance.⁸⁷

Risks to Moral Development

If schools treat the child as an object, a kind of “biological computer,” then education becomes a matter of calculating how most efficiently to train children to collect, sort, store, analyze, and apply information. The fact that information technologies are dramatically reshaping the economy reinforces the notion that children are “the Nation’s intellectual capital,” as the influential 1983 report

A Nation at Risk suggested.

“What is lost in all this,” writes Jeffrey Kane, “is that children are human beings whose minds are not a *public or corporate* resource. The source of the error is in assuming that children *have* intelligence, rather than that they *are* the embodiment of intelligence. Children not only process information but also exist as self-conscious human beings who construct meaning in their thinking.” And schools, whether they intend to or not, have a profound impact on how children discover or create meaning for themselves. “Every fact imparted, every thinking skill emphasized, however subtle, opens some possibilities for meaning and may

close others.”

In other words, for children, all education is moral education. From this perspective, a concept like “Web-based education” is an oxymoron, because moral education requires moral educators. As Kane puts it:

The educational imperative of our day is not to cultivate intellectual capital for the economy; it is not to teach children to process bits of information in formal ways to solve problems; and it is not to get them to store as much discrete information where “more” and “earlier” are the rule. It is to guide children in their development as whole persons; it is to help them to learn through direct and varied forms of encounter with the world as a foundation for clear, rigorous thinking; it is to bring all the resources of the culture to help them experience meaning, identity, purpose, and responsibility in the whole of life; and it to address the “I am” as being, rather than as abstraction or capital.⁸⁸

A Massive National Experiment

Schools are spending so much money — and so much time — on computers that many are cutting essential programs to try to keep up with the latest technology. Schools pushing intense academics in kindergarten, for example, often now linked to computers, have to sacrifice recess and creative play time — the very activities that researchers have identified as “warm-up” exercises for the young mind that pay off in academic achievement later.

Despite the Pandora’s box of hazards outlined in this chapter, corporate, government, and school officials are proceeding at full speed with plans to radically transform kindergarten and grade-school classrooms with high-tech machinery.

A panel of President Clinton’s top advisers on science and technology recognized this as the

massive national experiment that it is. Our children are the experimental subjects. That presidential commission called for stepping up this massive experiment, with no mention of how children will be protected from the risks to their health and well-being. It pointed to the tremendous amount of money the federal government invests in pharmaceutical research in arguing for large increases in research spending to promote the use of computers in education. But the panel failed to note that the clinical trials required before new drugs can be approved are so expensive precisely because drug companies are required, by federal law, to prove, above all, that new medications are safe, and, after that, that new drugs are effective in treating the conditions for which they are to be prescribed.⁸⁹

There are few examples, in the decades in which federal agencies have been actively promoting computers in elementary education, of federal funding for research designed to examine whether this prescription really is safe for children. The effects on children’s health of this massive experiment have simply not been considered.



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⁷ Dr. David Diamond, Massachusetts Institute of Technology Medical Center, telephone interview, June 30, 2000.

⁸ Brendan Connell, telephone interview, July 28, 2000.

⁹ Dr. Margit L. Bleecker, telephone interview, August 1, 2000.

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¹⁵ Alan Hedge (professor of ergonomics and director of the Human Factors and Ergonomics

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¹⁸ U.S. National Institute for Occupational Safety and Health, “Potential Health Hazards of Video Display Terminals,” as referenced in the online Health and Safety Manual of the U.S. National Institute of Environmental Health Sciences (www.niehs.nih.gov/odhsb/manual/man11f.htm), as of March 22, 2000). Also, Dr. Jeffrey Anshel, e-mail communication, July 26, 2000.

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⁵⁵ Meir Ben-Hur, ed., *On Feuerstein's Instrumental Enrichment: A Collection*, Arlington Heights, IL: SkyLight, 1994.

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⁵⁸ For example, Bill Dinsmore of the Learning Company, in a 1993 presentation, noted that it was

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