The Trumpeter (2001)

Computers, Culture, and the Digital Phase of the Industrial Revolution: Expanding the Debate on the Educational Uses of Computers

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Too often discussions about the uses of computers in education focus on specific issues such as whether computers enhance learning, how to exploit the global market for digital degrees from North American universities, the challenge of getting public-school teachers to integrate computers into more areas of the curriculum, and so forth. Even critics tend to focus on narrow aspects of the problem: Are computers more effective in raising math scores than in teaching other subjects? Does the use of computers retard the physiological and psychological development of young children? Is unequal access to computers contributing to the continuation of racial, class, and gender inequities in western society? Have educators, in reflecting the failure of universities to educate them to the questions that should be asked about the non-neutrality of technology, become puppets manipulated by the computer industry? The concerns of computer proponents and critics need to be framed in terms of a broader perspective—one that takes into account the cultural transforming characteristics of computers.

This broader perspective also needs to take account of how the cultural patterns reinforced by computers contribute to the digital phase of the Industrial Revolution that is now being globalized.[1] This broader framework of understanding is necessary to develop a critique that can illuminate how computers undermine the forms of knowledge and relationships essential to face-to-face and intergenerationally coherent communities, as well as how computers contribute to the ecological crisis. Critiques that are focused on single issues too often lead the proponents to search for a technological response.

Issues relating to the regeneration of viable communities that have a smaller ecological footprint, as well as the need to turn away from the pathway of introducing increasingly large-scale technological experiments into an already over-stressed environment should be the major concern of educational reformers—including both proponents and critics of educational computing. Introducing a technology that contributes to undermining communities, cultural diversity, and the self-renewing capacity of natural systems, is simply part of the rational management strategy that is putting us in the double bind of growing computer dependency and community/environmental destruction.

In his seminal book, *The Technological Society*, Jacques Ellul makes an observation that has particular relevance to understanding the influence of computers on the cultures of the world. Commenting on a characteristic of modern technology, Ellul wrote that “the individual, in order to make use of technological instruments, no longer needs to know

about his civilization."[2] In substituting culture for civilization, which is the more relevant unit of observation today, I would like to clarify the many ways in which the globalization of computer culture reflects both a basic ignorance of culture on the part of the experts who are promoting its further development, and a growing form of cultural amnesia on the part of the public that is being conditioned to equate the use of computers with the latest stage in our evolutionary development. This ability to be highly innovative in computer technology, while being ignorant of the impact of computers on different cultures, partly explains why critics have largely been ignored. The scale and forms of cultural change connected with computer-mediated thought and communication have implications that go far beyond what is too often interpreted as nostalgia for cultural traditions that are being lost. Indeed, the cultural changes now being globalized through the spread of computer technology relate directly to the world-wide acceleration of cultural trend lines that are contributing to the ecological crisis. Ignorance of how computers influence culture, our own as well as that of others, is not an insignificant issue. It may, in fact, be the most important challenge we now face.

How Computers Amplify the Nihilistic Elements of Modern Culture

Sherry Turkle, one of today's most acclaimed proponents of computer mediated experience, makes the following set of claims:

> I have argued that Internet experiences help us to develop models of psychological well-being that are in a meaningful sense postmodern: They admit multiplicity and flexibility. They acknowledge the constructed nature of reality, self, and other. The Internet is not alone in encouraging such models. There are many places within our culture that do so. What they have in common is that they all suggest the value of approaching one's 'story' in several ways and with fluid access to one's different aspects. We are encouraged to think of ourselves as fluid, emergent, decentered, multiplicitous, flexible and ever in process. The metaphors travel freely among computer science, psychology, children's games, cultural studies, artificial intelligence, literary criticism, advertising, molecular biology, self-help, and artificial life.[3]

Turkle is absolutely right about the areas in which these metaphors are shared, but she ignores that another name for the attributes of identity, ways of thinking, and values being "fluid, emergent... and ever in process," is nihilism. In certain academic circles it is called postmodernism, which is really a label that gives renewed legitimacy to the complex set of anti-tradition cultural patterns nurtured by the Industrial Revolution and the rise of modern science. Nihilism has been traditionally associated with ideas and values being experienced as relative and a matter of subjective judgment. One of its manifestations is that making collective commitments, as well as the authority (in Hannah Arendt's use of the word) of shared traditions and guiding moral principles, appear as anachronistic and thus as irrelevant to today's world. How computers contribute to the growing dominance of nihilistic cultural patterns that contribute to the relentless spread of consumerism and technological dependence, while being used for seemingly constructive purposes such as solving complex technical problems and modeling changes in natural systems, can be seen in the cultural amplification characteristics of computer-mediated thought and communication. Just as the characteristics of a telephone amplify voice over great distances while selecting out of the communication process the non-verbal messages, computers also select certain experiential and cultural patterns for amplification. It is important to note that the following list of amplification characteristics corresponds to the cultural patterns that served as the conceptual and moral basis for the Industrial Revolution. Unfortunately, the conceptual patterns marginalized and subverted by computers are the ones widely shared by cultures that have developed in ways that took account of the challenge of living within the limits of local bioregions.

Thinking is Based on Data

The widespread translation of cultural life into digitally based simulations and data bases has now made such words as “wisdom” appear irrelevant. It has also substituted the words “data” and “information” for the more complex phenomena that we previously called “knowledge.” In the past, knowledge was associated with a deep understanding of the patterns and relationships that were refined over generations of experience. The 17th century philosopher, René Descartes, helped lay the basis for the modern twin misconceptions that data is the basis of thinking, and that thinking takes the form of procedural problem solving that is free of the influence of traditions. He also helped to perpetuate the tradition of devaluing the nature and importance of embodied knowledge—which is also devalued by the experience of using a computer. Proponents of computers are now helping to globalize Descartes’ errors by equating access to data and the ability to simulate problem solving scenarios with the empowerment of individual thought. What is being marginalized by the growing influence of computers, and the cultural epistemology that it is based upon, is that thought is influenced by the metaphorical constructions of a cultural group. That is, cultures have different ways of knowing, and thus, as Theodore Roszak points out in *The Cult of Information*,[4] it is the “master ideas” or mythopoetic narratives (root metaphors) that serve as the schema for making sense of information. For example, it is the 16th century root metaphor that represented organisms and life processes as mechanistic in nature that underlies the thinking of current Western thinkers such as Kevin Kelly and Hans Moravec who view computers as eventually replacing humans in the evolutionary process. The cultural schemata that leads to this nihilistic view of the future stands in sharp contrast to how many cultures view humans as part of an endless spiritual cycle that is kept in balance through strict adherence to ecologically centered moral codes.[5] Differences in how tradition, time, moral judgments, family, death, embodied experience, and so forth, are understood in other cultures provides overwhelming evidence that thinking is rooted in and shaped by the deep symbolic constructions of the cultural group. Simply put, the equating of thinking with data contributes to the further marginalization of the importance of understanding the formative influence of culture. Without this understanding, it is impossible to clarify how computers influence the process of cultural change.

Amplification of the “Autonomous” Individual

The argument that computers empower individuals by making available massive amounts of data further contributes to the ideological justification for representing the individual as the basic social unit. Metaphors derived from computers, such as “navigate,” “cycling through virtual worlds,” “simulation,” “cyberspace,” and “virtual reality,” are based on the assumption that culturally autonomous individuals connect, change persona, and experience the electronically constituted environments of print, simulations, and virtual communities. What is distorted and simplified by this view of individualism are the many ways the individual’s thoughts, values, and behaviors are influenced by culture. While computers reinforce the mythic dimensions of “individual decision making,” the reality is that the language systems that are the basis of communication reproduce the metaphorically based patterns of thinking that give the members of a cultural group their distinct identity. Indeed, the way in which computers amplify the cultural tradition of thinking of language as a conduit through which supposedly objective information, data, and ideas are passed is of its more problematic characteristics. Science is also dependent upon this misconception, even as “objective” findings and theories are dependent upon the use of taken-for-granted root metaphors that frame what is accounted for, and what is ignored. The root metaphor of mechanism is especially prominent in shaping current approaches to brain research and in how the components of a cell are understood. Indeed, the literature on brain research does not mention the connections between the symbolic foundations of different cultural ways of knowing, and the role of metaphor in passing these cultural ways of knowing on to future generations. Nor do the other root metaphors that underlie western science put in focus the mythopoetic narratives that are the basis of

different cultures' moral frameworks, nor do they lead scientists to ponder the implications of explaining cultural change on the basis of Darwinian fitness.[6] In spite of the continuing influence of the conduit view of language, even among the most cutting-edge scientists, the reality is that language encodes in both the process of analogic thinking and the use of iconic metaphors such as "data," "intelligence," "tradition," and so forth, the root metaphors that guided earlier culturally and historically specific ways of knowing. The use of computers thus contributes to this tradition of ignoring both the individual's embeddedness in the symbolic systems of the culture that make thought and communication possible. It also continues the anthropocentric tradition, which is even evident in the management approach to environmental problems, that ignores how the individual is embedded in the natural systems that transform the sun's energy into food, sources of shelter, and technologies essential for human life. Being part of the larger ecology of interacting patterns of culture and natural systems is not part of the cultural experience that accompanies computer mediated experience.

Digitalized Culture, Temporality, and the Irrelevance of Elder Knowledge

The many technologies and formats for digitalizing various aspects of culture, from the paintings in the Louvre to historical documents and events, amplify a cultural experience of time (temporality) that is limited to the individual's subjective judgment about what is relevant. The past is thus experienced as something that is disconnected from the living present. Instead, individuals now encounter events, traditions, and personalities in cyberspace where their "subjective" interests and interpretative framework (which are rooted in modern cultural assumptions) determines what will have meaning. Similarly, the same way of experiencing the past from the vantage point of one's immediate experience influences how the future will be considered. Just as the authority of tradition becomes a matter of subjective judgment, responsibility for acting in ways that do not diminish the prospects of future generations of life are also subjectively determined. Computers mediate culture and personal experience in complex ways that have many benefits and losses—but among the many aspects of culture they do not enable their users to experience is a taken-for-granted sense of responsibility for the seventh unborn generation.

The mesmerizing characteristics of the Internet, and the capacity to digitize different forms of cultural achievement, hide another cultural amplification characteristic of computers that is directly related to the ecological crisis. The combination of being able to access information on a scale never before experienced, and our modern culture's way of representing individual judgment as the basis for deciding what aspects of the past are relevant, contributes to the widespread prejudice against elder forms of wisdom. While computer mediated culture involves subtle and complex forms of transgenerational communication, what gets carried forward are the expert systems and technical forms of knowledge that further the individual's ability to make decisions within the context of simulated realities. It is not a form of transgenerational communication involving wisdom of how to live meaningful lives within just and ecologically sustainable communities. Nor does the computer make possible the necessary forms of mentoring that will enable the younger generation to recognize the special responsibilities they must assume if they are to renew the wisdom of essential relationships, including the knowledge of place, for the generations that will follow them.

A summary of the cultural amplification characteristics of computers includes: representing data as the basis of thought, a conduit view of language that hides the metaphorical nature of the language/thought process, reducing culture to what experts are explicitly aware of, the authority of individual judgment and the corresponding reduction of the sense of cultural temporality to what the individual experiences as relevant, a machine mediated language that represents relationships as instrumental and individually centered (anthropocentrism), and the representation of the form of cultural intelligence

encoded in the language systems of computers as a universal way of thinking and communicating. The list of cultural reduction characteristics includes: marginalizing and hiding implicit cultural knowledge—or what Bateson refers to as analog knowledge, how language reproduces the epistemology of the cultural group, how individuals are nested in culture and culture is nested in natural systems, the complex way traditions are reenacted and modified as part of everyday experience, and the how the narratives of a culture influence the direction of future cultural development. If we were to look at the amplification and reduction characteristics of computers in terms of specific cultures found in India, South America, China, Africa, and so forth, the modern cultural biases of computers would be even more evident—particularly in how computers reinforce individually centered expressions of relativism (what Turkle calls the "fluid, emergent, decentered, multiplicitous, flexible, and ever in process" self).

The Double Bind of Globalizing Computer-Based Culture in an Era of Environmental Decline

Computers both reproduce the deep, cultural assumptions that were the basis of the Industrial Revolution while, at the same time, they introduce changes that put the dominant culture on an even more experimental pathway—in the workplace, in what constitutes community, in enhancing the police powers of the state, in the moral education of children, and in the loss of cultural traditions and knowledge passed on through face-to-face interaction. Issues surrounding these cultural changes have been addressed by such critics as Jeremy Rifkin, Langdon Winner, Jerry Mander, and Theodore Roszak. But their criticisms have not influenced the various segments of the computer industry to adopt a more reflective and cautious approach. For example, over 500 educational software programs are now marketed in North America to children in the four-to-seven-year age group; the industry continues to produce updated versions of the electronic war fantasies that Dungeons and Dragons made popular in the 1970s; states are allocating millions of dollars to train teachers in how to integrate the 5.8 million computers now in American classrooms into the curriculum; and corporations are using computers to transform themselves in ways that open up new markets and improve profit margins—which often involves placing manufacturing facilities in countries that have the lowest wages and environmental restrictions. While the proponents continue to represent these cultural experiments (experiments magnified many times over when introduced into non-Western cultures) as manifestations of progress, there are two aspects of the increasing influence of computers on the direction of cultural development that have been largely ignored.

In spite of the widespread belief that computer technology is enabling humankind to enter the Information Age, there is even more evidence that it will contribute to intensifying the destructive impact that this latest stage in the development of the Industrial Revolution has on communities, and on the natural environment. But this evidence is being ignored because of the widespread acceptance of the idea that we are entering a new era that will not have the limitations experienced in the past. The following description by Nicholas Negroponte, who is a professor at MIT, of what lies immediately ahead for the cultures of the world is typical of the combination of romanticism and cultural amnesia that prevents the real evidence of disrupted communities and natural systems from being acknowledged within the industry and by the public. It is important to keep in mind that he is describing how computers will transform the lives of all cultural groups:

> Computing is not about computing any more. It is about living . . .. As we interconnect ourselves, many of the values of a nation-state will give way to those of both larger and smaller electronic communities. We shall socialize in digital neighborhoods in which physical space will be irrelevant and time will play a different role. Twenty years from now, when we look out of a window, what you see may be five thousand miles and six time zones away. When you watch an hour of television, it may have been

> delivered to your home in less than a second. Reading about Patagonia can include the sensory experience of going there. A book by William Buckley can be a conversation with him.[7]

It is easy to dismiss the banality and misunderstandings reflected in this vision of life in cyberspace, but what is accurately represented is how computer mediated experiences, whether it be a conversation with Buckley or a member of the family, involve the further commodification of human/community relationships. A good case can be made that commodifying what used to be shared through face to face relationships now stands as one of the more destructive impacts of the ongoing Industrial Revolution.

As Karl Polanyi points out in *The Great Transformation*,[8] the Industrial Revolution in England introduced a basic change in the way the market functioned in the life of the community. Prior to this change, the determination of market values played a limited role in the life of the community, with market activity often limited to a specific social space and time of the week. With the expansion of the Industrial Revolution and the growing influence of liberal economic principles, the idea of the autonomous self-regulating markets was gradually extended into all areas of community life. Today, computers are the technology primarily responsible for extending the commodification process into previously unexploited areas of life—indeed, into areas of life that have been regarded as sacred by many cultures.

For example, the Human Genome Project, as well as other cutting-edge areas of science now being used to genetically engineer new forms of animal and plant life and thus turn them into commodities, are dependent upon computers.[9] Entertainment, advertising, education, health care, among others, are also dependent upon computers. The pivotal role that computers now play in coordinating economic activities on a world-wide basis through the flow of information is explained in the following way by two MIT professors, Thomas W. Malone and John F. Rockart:

> Coordination-intensive structures (computer networks) do not just link different people in the same companies. Most of the most interesting new structures involve links among different companies. For example . . . (in the U.S. textile industry) these electronic connections link companies along the production chain, from suppliers of fibers to the mills that weave the fibers into fabrics, to the factories that sew garments and, ultimately, to the stores that sell the garments to consumers.[10]

In addition to coordinating information on consumer response to products, thus enabling manufacturers to make refinements that will further expand sales, Malone and Rockart envision computers making further contributions to the rapid exploitation of niche markets that are discovered within the traditional patterns of community life. One advantage they see as specifically related to computers is the ability of "electronically mediated markets [to] assemble armies of 'intellectual mercenaries' virtually overnight." While ignoring the social and psychological implications of being part of a standby workforce that is electronically on-call, they focus instead on the efficiency that computers bring to coordinating what can euphemistically be called the "forces of production": "if a manager has a job to be done, such as evaluating a loan or designing a lawnmower, he or she could quickly assemble a team by advertising electronically or by consulting a data base of available people."[11] This example, which can be multiplied a thousand times over, reveals the level of moral sensitivity that characterizes the thinking within the field, just as Negroponte's vision of a common culture of simulated involvement reveals a basic misunderstanding of the cultures that exist beyond the campus of MIT.

Writing from a Third World perspective, Gerald Berthoud sums up the totalizing demands on community life that Western technology (particularly computer-based

technologies) now makes possible:

> With the present tendency to impose market mechanisms and principles on a global scale, development is held to be possible only for those who are ready to rid themselves entirely of their traditions, and devote themselves to making economic profit, at the expense of the whole gamut of social and moral obligations . . .. We are all subject to the compelling idea that everything than can be made must be made, and then sold. Our universe appears unshakably structured by the omnipotence of technoscientific truth and the laws of the market.[12]

The significance of the global changes being effected by combining the ethos of the Industrial Revolution with the information processing capacity of computers go well beyond the right of cultural groups to retain their own identities and traditions, including traditions that restricted market activities to the margins of community life. Today, the globalizing of a consumer culture, where the technologically elite class continually create artificial markets for their latest innovations, is contributing to the disruption of the transgenerational forms of knowledge that enabled cultures to develop complex symbolic worlds and community traditions attuned to the characteristics of local ecosystems. Knowledge of the local bioregion (including the life cycle of plants and other forms of life that could be utilized for food, medicine, clothing, shelter, and so forth) was essential to the long-term sustainability of the cultural group. Contrary to how modern, commodity oriented thinkers view them, these cultures developed exceedingly complex symbolic worlds that explained the nature of the larger moral ecology that was celebrated and respected as part of community life.

As an example of this complexity, scientists now studying the biological knowledge of Mayan cultural groups found that 50 different medicinal plant species are used in the treatment of gastrointestinal conditions.[13] The local knowledge of biodiversity of other traditional cultures, ranging from the over 30,000 different varieties of rice grown by Indian farmers before the Green Revolution and the 7, 500 species used as medicinal plants in Indian villages,[14] to the hundreds of varieties of corn developed by the Indians of the Southwest—to cite only a few examples, is being lost as traditional cultures undergo modernization and integration into the market system now made increasingly possible by computers.

We may be mildly concerned that American youth can identify hundreds of corporate logos, but only a few plants in their local environment. But when we begin to grasp the scale of the impact that a fully developed commoditized culture has on the environment, it becomes increasingly clear that the world's ecosystems cannot sustain the present rate and form of technological development. The global approach to integrating all cultures into a monoculture of Western market values and technology, which is being resisted in some regions of the world, contributes to the possibility of unintended consequences that could have a devastating impact on the future of life as we now know it. The scale of future risk is summarized in the following warning:

> With one hundred thousand synthetic chemicals in commerce globally and one thousand additional new substances coming onto the market each year, there is little hope of discovering their fate in ecosystems or their harm to humans and other living creatures until the damage is done.
>
> Colborn, Dumanoski, Myers[15]

The further commodification of individual and community life, as envisioned by the advocates of computers, can also be understood in terms of what Mathis Wackernagel and William Rees refer to as the "ecological footprint" of a population group. As a unit of analysis, the size of the ecological footprint represents the level of "resource consumption

and waste assimilation requirement of a defined human population or economy in terms of a corresponding productive land area."[16] Wackernagel and Rees point out that, by identifying the different forms of energy use and waste connected with patterns of consumption, the ecological footprint of the average American requires 5.1 hectares of productive land, the average Canadian requires 4.3 hectares, the peoples of India require .4 hectares, and that the world-wide impact is 1.8 hectares. They further note that if the entire world were to adopt the North American consumer life style it would take two additional planet Earths to produce the resources, absorb the wastes, and otherwise maintain life-support.[17] Understanding the double bind of globalizing a computer/commodified lifestyle also needs to take into account that the world population is now increasing at a rate of over 90 million a year, and that topsoil, fresh water, forest cover, and fisheries essential for supporting the growing world population are being degraded at an accelerating rate. Given the increasing evidence of environmental disruption, we have to ask whether the contribution computers make to accelerating the forces promoting consumerism, as well as their influence on the loss of local knowledge and traditions, far outweigh the importance of the areas in which they make a genuine contribution.

Connections Between Computers and High-Status Forms of Knowledge

As Gregory Bateson points out in *Steps to an Ecology of Mind*,[18] the computer is part of a larger ecology of Mind—which for Bateson involves the interaction of culture with the natural systems that sustain it. It is this larger culture that needs to be understood if we are to address the ideological foundations that support current efforts to create a global computer-based culture. While the current state of cultural development is being framed by academics in terms of a largely fruitless modern/postmodern argument, I would like to use a different set of categories that take account of the fact that the majority of the world's population is neither Western in its conceptual and moral orientation, nor has embraced (except for its elite classes) the commodification of knowledge and relationships that is the hallmark modern culture. These categories also take into account that a degraded environment is one of the most serious challenges facing all cultural groups. Furthermore, these categories, which can be differentiated in terms of high- and low-status forms of knowledge, reflect the influence of Western ideology and, in particular, the educational institutions that over the last hundred years have been primarily responsible for determining the mix of thought patterns, values, modes of communication, and cultural myths that are worthy of study, certification, and world-wide dissemination.[19] Socializing students to these status differences begins in the elementary grades, but it is the university that plays the more pivotal role in maintaining the symbolic boundaries, and in promoting the further development of theory and research that will lead to new technologies and forms of commodification. The university also provides the certification necessary for access to positions of employment and authority with the elite groups who benefit economically and politically from high-status forms of knowledge.

The list of characteristics of high-status knowledge include the following: an emphasis on the individual as the source of ideas, values, and creativity; an anthropocentric view of human/nature relationships; an absolute certainty about the progressive nature of change (and thus a devaluing of tradition, except when it has an instrumental value); a secular/evolutionary view of life processes; an increasing reliance on the scientific method and market forces to dictate the direction of technological development; and a messianic approach spreading the process of commodification into every aspect of individual and community life. These characteristics are also the ones that are amplified through the various uses of computers. To state the connection between computers and high-status knowledge more directly: computers are the principal technology that now promote the globalization of high-status knowledge and the elite groups who benefit from them. This connection accounts, in part, for the lack of a deep culturally and ecologically

informed criticism of computers. Understanding this connection also provides a broader perspective on the layers of symbolic legitimation that need to be reconstituted if technology (including computers) is to be subordinated to the moral imperatives of sustainable community/nature relationships. That is, overturning what is conceptually, morally, and ecologically problematic about the foundations of high-status knowledge is essential to altering the present course of the digital phase of the Industrial Revolution we are now entering.

Given the ground rules that universities and other elite groups have established for determining what constitutes legitimate discourse and evidence, it will be difficult to be taken seriously when arguments critical of computers are grounded in a perspective that has already been accorded low-status, and thus as reflecting a backward and unenlightened pattern of thought and values. A further difficulty is that the evolutionary schema that underlies high-status patterns of thinking will lead to the problem mentioned earlier, which is that criticisms will be interpreted as reflecting the naive and romantic assumption that the clock of technological change can be turned back to a simpler and more pastoral form of community. But what is often overlooked is that the cultural groups categorized as backward and undeveloped, and now as untapped commodity markets and sources of genetic material that can be patented by multinational corporations, are contemporary in every sense except for the modern technology they have avoided embracing. This point needs to be constantly emphasized because the evolutionary schema of understanding leads to thinking of cultures that do not exhibit the characteristics of modern technological development as not providing an appropriate basis for criticizing more progressive forms of cultural development.

Instead of looking to the prescriptions offered by people within the field of computing, we need to begin to judge the development and uses of computers in terms of moral criteria that take account of the quality of community life, as well as the ability of communities to limit their demands on natural systems. This will require a radical shift away from the current criteria of profits, increased efficiency and control in the production process, creating new markets, and learning to live in the relativistic world of simulations and digital communities. The double bind that limits people within the computer industry, as well as the general public, from being able to articulate alternative cultural criteria for judging the moral and ecological merits of new technologies is that the patterns of community life not dependent upon commodified relationships are not adequately understood. The prejudices that accompany the acquisition of high-status knowledge in universities make it appear that learning about the patterns of moral reciprocity surrounding mentoring, healing, celebrating, educating, playing, socializing, growing food, and so forth, is both irrelevant to today's world, and not appropriate to a high-status lifestyle. Learning about the non-commodified aspects of community life is thus seen as low-status—a message that is reinforced through the media and at all levels of the educational process. This systemic based inability of university graduates to understand the complexity and ecological importance of non-commodified community relationships and traditions ensures that resistance to the pressures of technological and economic development will come only from marginalized cultural groups.

Public schools and universities also contribute to the moral, intellectual, and ecological double binds underlying high-status knowledge by failing to clarify for students the differences between scientific narratives of how life began and evolved, and the narratives of ecologically centered cultures that represent humans as part of a moral/spiritual ecology that encompasses all forms of life. While the latter forms of narratives clearly focus on the moral obligations of humans within the world of reciprocal relationships with other forms of life, scientific narratives are open to a variety of interpretations—including the one that holds that in a world of moral relativism the best strategy is to act in ways that ensure the future survival of one's genetic stock. In not being able to articulate how scientific accounts of human evolution involve both the delegitimation of the narratives of other cultures as well as the "survival of the fittest" way of understanding that follows from current reductionist thinking that assigns

responsibility to the inherited genetic codes, the public's ability to articulate the boundaries between appropriate and inappropriate uses of computers is further undermined.

There are other aspects of high-status knowledge learned in and certified by our educational institutions that must be reconstituted in ways that take account of the ecological footprint of an increasingly commodified world. The failure to understand that intelligence is not an individual attribute, but reflects the cultural group's mythic structures and ways of knowing, is particularly critical to recognizing that computers encode, reproduce, and now give further legitimacy to a specific form of cultural intelligence. Understanding that creativity is not an attribute of the autonomous individual, as the liberal ideology would have us believe, but is also based on the cultural group's taken-for-granted conceptual and moral framework, would also help to articulate the limits of computer technology.

While experts within the computer industry and the general public may not be comfortable with the argument that a more limited and sane use of computers depends on understanding these broader conceptual and moral issues, fundamental changes in the development, representation, and world-wide promotion of this technology depend on making equally fundamental changes in the educational process. That is, challenging the cultural myths that underlie the high-status forms of knowledge is necessary to altering the present technological vision that is reflected in the thinking of such computer proponents as Turkle and Negroponte. An immediate step toward educational reform would be for universities to offer courses that critically examine the ideological and epistemological continuities between the machine and digital phases of the Industrial Revolution. These courses also need to put in perspective the connections between computers, the drive to further commodify community life, and the other ways computers contribute to the ecological crisis. Computers are not a culturally neutral technology, and they are not a Promethian technology that will enable us to control our destiny as we further enter the digital phase of the Industrial Revolution. Rather, it will be the degraded state of natural systems that will determine humanity's fate.

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