Introduction: Data-Driven Democracy? Social Assessment of Educational Computing[1]

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Interest in educational computing has grown explosively in recent years, with many school districts rushing to invest in new technologies. Hundreds of millions of dollars are being spent on hardware and software in hopes of "equipping" students with skills that are said to be needed in today's world of intense economic competition. At a time when shrinking resources at all levels of government have made it extremely difficult for many school districts to keep up with overdue building maintenance, buy up-to-date textbooks, or even, in some cities, keep schools open for the requisite number of days each year, is this enormous investment in computing technology a good idea?

The question is, of course, one without a simple "yes" or "no" answer. There is little doubt that some instances of educational computing have been extraordinarily valuable, some others have been downright foolhardy, and still others have been simultaneously beneficial for some students and harmful to others. Reaching a useful answer will require a more finely grained question: investment in what kind of educational computing? a good idea for whom? under what conditions? We need to know who is affected, how, and by what specific practices, but that sort of analysis is generally not available. And without it, the tremendous pressure schools are under to "keep up" technologically is likely to push them down unwise paths. In this introductory essay, I would like to suggest what might be entailed in performing such an analysis, which the book as a whole is an initial attempt to provide.

The Computer as a Symbol

One feature that distinguishes the work collected here from most other efforts to evaluate the computing presence in schools is an abiding concern with how the computer functions as a *symbol* of the quality of education children are

receiving. As with any symbol, this one has an indeterminate meaning, enabling various social actors to attach distinct meanings to it. Because it can be read in very different—and even contradictory—ways, the computer serves as an umbrella under which disparate groups can cooperate on a seemingly common agenda. Although all may agree on the importance of enhancing the technological resources of schools, and support that goal via similar rhetoric, what unites them is the deployment of a shared symbol more than shared interests or a shared vision of the future.

The power of this symbol depends on an unstated yet powerful set of assumptions about the nature of technology. Among those assumptions are that computing technology benefits all students equally, as a neutral instrument with no connection to the unequal distribution of power along lines of gender, race, class, religion, and ethnicity; that access to such technology is a guarantee of upward social mobility; and that wider facility with high technology will alleviate the problems of the United States economy. It is assumed that anything involving new technologies must be an improvement; that it can, and indeed will, make life much easier for educators who now suffer in undertechnologized situations.

One of the most significant assumptions is the belief that we can deal with the new technologies in a purely instrumental way. The issues are seen simply as only technical questions of how best to apply the technology toward goals around which a consensus is assumed to exist. A supposedly neutral instrument like the computer can then be considered in the narrow terms of, say, cost-benefit analysis. If it meets "our" goals—elevated test scores, improved competitiveness, a more highly skilled workforce, and so on—it is "good," and we need think only of how to use it most efficiently in pursuit of those goals.

Despite their popularity, these assumptions are of dubious validity. Far from being neutral instruments, computers, like other technologies, are involved in many ways in the construction and use of power: in the way they are designed and built, in how they are sold and to whom, and in how they are used. They partake in an epistemology that promotes certain visions of knowledge and notions of who counts as a knowing subject. We need to ask what characteristics of the technology interact with the social context of its use to benefit some people at the expense of others and to reinforce existing power relations; and what possibilities exist for constructing alternative contexts of use favoring more progressive outcomes, for breaking down existing power relations. The relevant issues are demonstrably not technical ones; this is what I mean in advocating the view that technology is a social practice.

If the computer is a symbol, and the kind of education (and society) it represents is the object of strong desires, but with just what it does represent

being a disputed matter, then this book is an intervention in the dispute over what to read in the-computer-as-symbol. The way we describe any phenomenon, the stories we tell about it, shape what we do and don't see in it (see the chapter by Mary Bryson and Suzanne de Castell in this volume), and multiple stories can be told about technology. The "technological determinism" story, for instance, presents the emergence of a new technology in a way that highlights its impact on the way we live; the "technology as a social practice" story, on the other hand, highlights the actions of those individuals and institutions responsible for introducing the technology. Which story one tells is a political matter of grave importance.

What follows is the sketch of a story that develops a social assessment of educational computing by challenging the assumptions behind common readings of the computer.

Thinking about Technology

Most writing about computers and schools has a narrow, internalistic orientation. It implicitly assumes that technology is beneficent, sure to bring us a better tomorrow if we simply attend to a little fine-tuning now and then. Thus the myopic focus on the technology itself and on how to do things with it. Some critics of technology make the opposite assumption that technology is inherently evil and is properly dealt with only through complete avoidance. Both positions are ahistorical in the sense that they assume that the impact, or meaning, of a given technological artifact is constant at all times and in all places. They fail to see that the impact can vary with the context, according to the purposes of the humans involved in the particular situation. They attribute too much to the technology itself, treating it as an implacable external force that autonomously drives the rest of society in one direction or another, and not enough to the social context of its use. Such technological determinism ascribes agency to technology rather than to people; it naturalizes technological change, implying inevitability and cloaking the social processes actually accountable for the path taken. The result can be a public sense of resigned acceptance, and a (learned) helplessness in the face of technological change, unless we shift our focus from the technology per se to the surrounding culture.

But overemphasizing the social context can lead to another problem: the technology may come to be seen as a "neutral tool" whose impact depends wholly on the intent of its users. This line of thought is extremely common; references to computers as intellectual tools, flexibly applied to whatever problem one wishes, have proliferated wildly. The "tool" metaphor is appeal-

ing but misleading: tools can be flexible but only within certain limits, because their design inevitably favors some applications and prohibits others. The claim that a hammer can be used to build anything overlooks the fact that hammers don't work particularly well with screws. Calling computers "neutral tools" amenable to any application utilizes the same logic as the slogan "guns don't kill people, people kill people." It is true that guns can murder only through the agency of human murderousness, but guns as a technology lend themselves to certain uses. They have a built-in propensity to be used in certain ways toward certain ends. They may depend on human action to consummate those ends, but the predisposition exists in the design of the artifact before it ever gets used.[2]

What I have said thus far may suggest an opposition between a technology's predispositions and its context of use, with one located "in the technology" and the other "in society." But that apparent opposition exists only if we limit our view to the present. Where did the built-in propensities, now located "in the technology," come from? They originated in the social context that was in effect when the technology was designed; they reflect the goals and assumptions of the people who created the technology. There is no inherent opposition between built-in factors and social factors, for what is now built-in is simply a petrified form of past social factors.[3] Recognizing both considerations as rooted in the social is important, for it reminds us that both result from human action, rather than from some immutable fact of nature. Of course, what is past is past, and a given technology's propensities, being the sediment of the past, cannot be changed. Once a piece of technology has been designed, its predispositions are locked in. But if we keep in mind that what is now fixed need not have turned out as it did, that it might have been different, we will prepare ourselves for actively shaping the technologies of the future, instead of passively adjusting to whatever happens to come along.

What, then, would constitute an adequate analysis of the likely impact of a technological artifact (the computer, for instance)? On the one hand, we need to look at the site where that artifact is put to use. We need to consider who is using it and why, what goals those people have, and how they're likely to utilize the technology in pursuit of their goals. Otherwise we risk assuming that the artifact will have the same impact everywhere, under all circumstances. At the same time, we need to examine what the technology carries with it into any context. We must ask what predispositions constrain how it may be used, keeping in mind that however stuck we are now with those predispositions, they were not inevitable but resulted from someone's pursuit of their goals, lest we fall into thinking of the artifact as a neutral tool equally applicable to any purpose.

In other words, we need to remain attentive to the way technologies both

reflect and *affect* the surrounding social conditions.[4] But one further element needs to be present: both halves of the analysis must be attuned to the operation of power. In classrooms, as elsewhere, some groups and individuals have more power than others and are consequently in a position to parlay the presence of a new technology into even greater advantage than they previously possessed. Understanding the effect of adding a potent artifact like the computer to the classroom hence requires perceiving whatever aspects of the social structure involve power differentials. Controlling the effects of new technologies may well necessitate altering social relationships rooted in unequal power.

The rest of this essay reflects the twin concerns outlined above. The next section considers the context of use, the conflicts now ongoing in educational settings, and how computers are utilized by the parties to those conflicts. The following section focuses on the propensities built into computing technology, the baggage it carries as a result of its cultural heritage and the institutional setting of its development. The last portion provides an overview of the remainder of the book.

The Context of Use: Computers and Existing Agendas

Pressure to ensure that students acquire computer-related skills has arisen from several directions. Business groups, anticipating the demands that may be placed on the next generation of workers, are one source, even though most new jobs actually will be in the low-skill (and low-pay) service sector. Professional educators also have been urging schools to furnish students with knowledge associated with the new technologies; the recent National Council of Teachers of Mathematics proposal for a restructured curriculum in mathematics has urged "technology-rich classrooms" where students will be "freed" from text-based curricula and teachers will be able to present their subjects in greater depth and sophistication.[5] Pressures also issue from middle-class parents with jobs centered on manipulating information (in paper or electronic form), whose own upward mobility appears to have depended on values and skills connected to technical knowledge, and who consequently place the inculcation of such a sensibility at the forefront of what they expect schools to do for their children, particularly at a time when stable employment is increasingly scarce. For such parents, a computer-based curriculum appears to guarantee that these particular students will be ready for the demands of the best universities and the increasingly competitive paid labor market later on.

Each of these groups (and multiple factions within each group) has a distinct agenda, more general than and prior to their engagement with educa-

tional computing. The arrival of the technology offers an opportunity to advance these agendas, and, not surprisingly, each actor's stance regarding proper goals and methods for computer use is consistent with their own interests, with the eventual outcome depending largely on the course of contention among them.

Spanning the various agendas as an underlying condition, and suffusing their rivalry, is the rationalization of public life. Among other civic institutions formerly governed by alternative standards, schools are becoming ever more subject to economic reasoning. Under pressure from many quarters to improve their "productivity," to maximize some measurable output (frequently standardized test scores) while containing their costs, educational institutions are increasingly being run as businesses. That practice is, of course, not entirely new. A previous generation of reformers explicitly modeled schools after factories, and outspoken involvement of the business community in various bodies making public recommendations on educational policy is a time-honored, well-established practice. Business leaders were prominent among Progressive Era reformers, for example, and the rhetoric of that movement emphasized the adoption of impersonal, businesslike methods by local government (including schools) as a remedy to the wasteful corruption of fief-like big-city machine politics. But some recent applications of business methods to education are actually quite novel.

The various proposals for some sort of voucher system would directly convert schools to businesses in a literal sense. Meanwhile several cities have hired private firms to operate individual schools or entire districts on their behalf. Of course, such arrangements have not spread unopposed. Consider the rapid rise, and even more rapid fall, of Education Alternatives, Inc., with the recent cancellations of its sole remaining contracts (with Baltimore and Hartford), due in part to community opposition. Clearly many parents and professional educators continue to resist the extension of the profit motive into public education, and at times quite effectively. Such responses, however, face an uphill battle in an environment that is increasingly characterized by an apparent "naturalization" of economic logic. The business presence in oversight of public schools was dramatized when the governor of California nominated a specialist in turning around failing corporations, with no background in education, to be the state Superintendent of Public Instruction: "The 62-year-old Mr. Sigoloff is known in the corporate community for his cost-cutting tactics in making troubled companies profitable. His nomination . . . is the strongest indication yet that public education is turning to the private sector for help in turning around the financial and managerial problems of school systems. . . . Mr. Sigoloff said in his statement that he intended 'to insure that whatever resources are available for education will be spent efficiently and

appropriately'" (Celis 1993). There is no mention in the article of the role of the private sector in *creating* the financial problems of school systems they now offer to solve, and ensuring that few resources will be available to be spent (efficiently or otherwise), through insisting on low tax rates and demanding exemptions from local taxes in return for locating their operations in given communities.

Administrators in higher education have embraced the business mindset as thoroughly as have some of their K–12 counterparts. A *Wall Street Journal* article describes cost-cutting measures at Salem College in North Carolina: "Salem's president, Julianne Still Thrift,[6] explains such measures with the business-world language that has become common among college administrators. 'It's the same here as at IBM or AT&T,' she says. 'I've got to have a slimmer staff, I've got to produce more with what I have, and I've got to market aggressively'" (Horwitz 1994). Such pressure to "produce" more efficiently, to yield a higher level of measurable student performance with little or no increase in funding, is one reason for the influx of computers. Just as their use in the business world enables firms to produce more with fewer employees, it is hoped that computerizing the operations of the educational world will enable more learning to happen without hiring more teachers. "Roger C. Schank, director of the Institute for the Learning Sciences at Northwestern University, figures that classroom versions of the interactive training systems he is designing for industry could be a big factor in fixing America's schools. How so? 'We need a way to economically provide individualized instruction,' says Schank. 'Computers provide that economy'" (*Business Week* 1994, p. 82). While Schank's statement stands out for its directness, its substance has long been expressed. As early as 1967, Patrick Suppes was promoting computer-assisted instruction on the same basis. It would free teachers from the bulk of routine whole-class instruction, he wrote, so they could concentrate on working individually with students without the need to hire additional staff, thus offering "perhaps the most practical hope for a program of individualized instruction under the supervision of a single teacher" (Suppes 1980 [1967], p. 234).

Unfortunately for this line of argument, far from saving money, adding computers to the classroom commits the school to *additional* spending in the future (for software, equipment upgrades, maintenance, staff training, etc.) and actually *increases* teacher workload rather than reducing it (see Ragsdale 1988, p. 207, for citations to studies demonstrating the added burden on teachers). With teachers already pushed to the limit as schools "streamline" their operations, adding new responsibilities is practicable only if something else is dropped. Reducing class sizes would be a healthy solution, but that would mean spending more on teacher salaries, just the opposite of the economies

computer advocates are promising. Some even suggest computer purchases should be funded by increasing class sizes further to save on salaries.

The argument from economic efficiency just doesn't hold, even in terms of a narrow cost-benefit analysis. Other pedagogical innovations, like peer tutoring programs, produce better results more cheaply (studies cited in Tucker 1985, p. 15) without consuming resources from all sides as computers do. But given that the computers are there, and the teachers are increasingly short on time due in part to the computers' effect on school budgets, the computers do get used. The chapter by Michael Apple and Susan Jungck in this volume shows how the day-to-day realities of teachers' lives lead conscientious professionals to employ an utterly routinized and vapid computer curriculum, simply because it was already prepared (freeing them from having to write one) and it kept the students busy (freeing the teacher to complete other tasks). Perversely, the least intellectually engaging instructional software (such as drill-and-practice programs) can become the most attractive to teachers—for keeping students wholly occupied in a known activity with few surprises to require the teacher's attention, for a predictable amount of time—because of work conditions brought about partly by the very reforms touted as freeing teachers to spend more time working with students individually.

Thus far I have stressed how running schools as though they were businesses provides one impetus for purchasing computers. A different way of applying economic logic to schools is to treat them as a potential market or a customer base, which in fact they are. With several million microcomputers already in U.S. schools alone, educational institutions are a significant source of sales for both hardware and software manufacturers.

A variation on treating schools as a market for new products is the practice of packaging access to their inhabitants as a product to sell to someone else. Channel One, the satellite-delivered news program carrying paid advertisements, is transmitted to more than 10,000 schools. This enterprise (owned by K3 Communications since the collapse of Chris Whittle's financial empire) is notable for converting students themselves into a commodity, as the program's sponsors purchase access to the captive audience. Moreover, a report in *Media Culture Review* (cited in Aufderheide 1994) found that schools in poor districts sign up disproportionately for Channel One. Schools that have the least to spend on texts are the most likely to depend on Whittle's (now K3's) version of public affairs, a situation hardly likely to diminish the gap between the kinds of education available in poor and wealthy districts.

Another way to generate profits via the schools is to enlist them in training students to be consumers of one's products, creating a future customer base.[7] It is no coincidence that regional telephone companies are generously

underwriting school purchases of computers at the very same time they are busily seeking regulatory changes or merging with cable television operators in preparation for offering new information services piped into homes. For the new products to be profitable, someone has to buy them. In addition to funding general educational computing, the phone companies are also more directly promoting school use of new telecommunications services. The following announcement, headlined "Classroom of the future," was enclosed with one of my phone bills:

> At Ameritech, we want to see our innovations help prepare today's children for the changing world of tomorrow. We're creating a traveling exhibit, called *SuperSchool*®, to show schools how communications technology can improve the quality and efficiency of education. The SuperSchool classroom demonstrations include distance learning—where students attend classes in distant locations via interactive video and teleconferencing, and home learning—where people can study on their own schedules and busy parents can get more involved in their children's education.

This one paragraph manages to use all the symbolic terms prevalent in futurist rhetoric: 'change,' the 'world of tomorrow,' 'quality,' 'efficiency.' One might wonder, though, if the purpose is to show *schools* how beneficial communications technology is, why is the exhibit being advertised to the general public? Wouldn't it be more "efficient" to demonstrate the benefits directly for school officials? Or does the exhibit have more to do with cultivating broad-based public pressure on schools to "recognize" the evident benefits? Perhaps this is grassroots politics as an instrument of corporate interests.

Another way economic rationality is applied to schools is by stressing their supposed responsibility to prepare students for the workplace. Equating schooling with the production of a labor force is, of course, not new. An earlier generation of reformers rallied to the banner of "manpower" planning (a label whose gender politics are replicated in slightly more subtle form by today's reformers). But the prominence of information technology lends some distinguishing features to the current version of this outlook.

Many claims about how schools "need" to change begin with discussions of how the workplace has changed recently. There is much talk about the "post-Fordist" mode of production, and "flexible manufacturing systems." In the new economy, the story goes, rigid, centralized organizations that do one thing with machinelike efficiency are out. Firms must be adaptable, opportunistic, quick to respond to constantly changing circumstances, "lean and mean," all of which implies considerable dependence on information technologies to track both external conditions and the firm's operations. Labor-management trench warfare is no longer affordable; it must be replaced by a

more collaborative teamwork model. And the new firm needs a new worker: rather than being a cog in the machine, s/he must exercise responsibility, recognize what needs to be done and do it, solve problems creatively.

Accordingly a new education is called for: to thrive in a work environment involving continual shifting to new tasks, students will need to become self-motivated learners who are prepared to keep acquiring new skills their whole lives and are adept at "critical thinking" (which has come to mean simply applying their skills to whatever unfamiliar situations may be presented to them, rather than questioning and challenging the premises of those situations). Most of all they'll need proficiency with the high-tech equipment that will typify their work environment. Tales of this sort often refer forebodingly to the supposed advantage other nations enjoy over the U.S. in these matters, with the admonition that we can save our standard of living from plummeting only if we make whatever sacrifices are necessary to retool our schools and companies along these lines.

So what's wrong with this story? (See Robins and Webster 1989, chapters 4 and 6, for a fuller development of the following points.) For one thing, it blames schools for problems they can't solve. It is simply not the case that the failure of the schools to provide enough of this new kind of worker is what's constraining the economy. Jobs are in short supply, especially full-time, permanent ones. Even if every graduate matched the profile of the post-Fordist worker perfectly, there still wouldn't be post-Fordist jobs for them. Although the occupations with the greatest *rate* of growth are in prime, high-tech fields, the actual *number* of such jobs being created is quite modest, as the high-percentage increases are from a small initial base (discussed in Apple 1996, pp. 68–90). The vast majority of new jobs being created are in relatively menial service occupations. The Bureau of Labor Statistics projects that the occupation in which the most new jobs will be created over the next decade is salesclerk, followed by nurse, cashier, general office clerk, truck driver, waiter/waitress, nursing aide, janitor, and food preparation worker (*The New York Times* 1994). Even though nurses are relatively well paid, the median wage across all these occupations is approximately $14,500 *if* one were employed full-time, and new entrants are likely to start well below the median.

Clearly, what the post-Fordist labor market presents is not a ravenous demand for as many self-motivated, multiply skilled, critically thinking young people as can be supplied, but a split demand for a few such fortunates and a much larger population shunted into marginal and temporary work, at best. The "flexibility" in flexible manufacturing includes payroll flexibility, wherein the employer adds and drops workers immediately as they're needed. For increasing numbers of workers, that means temporary employment. (In

fact, the temp agency Manpower is now the largest employer in the U.S.) Moreover, even for those working consistently and in highly technologized environments, high-tech schooling is largely irrelevant. Productivity on the job is essentially unrelated to what happens in school, and the skills needed are overwhelmingly acquired in the workplace (see Collins 1979, chapters 1 and 2).

The impending Information Age is nonetheless a convincing *pretext* for initiating major educational change. Despite the irrelevance of curricular content to job performance, the rhetoric of high-tech schooling for a high-tech economy has lent effective support to various reforms, including the installation of computers in schools. One reason the rhetoric has been so effective is that parents are legitimately worried about the job prospects of their children. No matter what the data say, common opinion has it that computer skills will be an increasingly necessary job qualification, and no one wants to be left behind. Groups whose participation in the mainstream economy is already marginal fear being totally closed out if their schools don't keep up. And groups which historically had no trouble securing more lucrative positions are finding it more difficult. What was once virtually automatic upon receiving a college degree, for instance, is now not so easy to obtain. With wider distribution of educational credentials and shrinking opportunities for employment, the same credentials no longer "buy" what they once did.

If such an effort by the historically privileged to redifferentiate themselves is, in fact, a significant element of computer adoption by schools, one would expect parental pressure to be a visible factor in computer purchases. That's exactly what Marc Tucker of the Carnegie Forum reports. In his experience, the push for computers in schools came not from educators but from upper-middle-class parents. The pressure was also backed up with money: in one year during the major build-up, funds raised by suburban parents paid for fully 27 percent of all computers bought for U.S. schools (Tucker 1985, p. 14).

These actions can be seen (borrowing from Collins 1979 again) as a response to credentials inflation. Although curricular changes have little to do with on-the-job performance, new technologies of production do enable the creation of new forms of cultural currency. The older credentials have become badly inflated; everyone has them and they no longer guarantee a cushy sinecure. The formerly privileged react by creating a new credential. Initially, of course, no one has it, so the first few to acquire it are now distinguished from the crowd that has inflated the old credentials, and stand to benefit substantially. Once the computer credential catches on, a mad rush for it is likely to follow, yielding exponential growth in school computers—precisely what ensued throughout the 1980s. But not everyone is in a strong enough position

to obtain access to the new credential. The computer-intensive classroom is a very expensive innovation that is out of reach for the many communities that cannot afford it (or lack the clout to force their school officials to find a way to afford it).

Meanwhile, efforts to promote educational computing encounter in schools an institutional history of reluctance to adopt new technologies. Larry Cuban has written of the high hopes that have been frustrated throughout this century, as every twenty years or so a fresh wave of instructional technology has arrived, promising to "revolutionize" education, with ultimately little effect: film, radio, broadcast TV, VCRs, and finally computers (Cuban 1986). What tends to be adopted are those aspects of the new technologies that can be fitted into existing practice; the rest somehow never get assimilated. The rejection of the more transforming possibilities isn't necessarily due to any hostility toward innovation on teachers' part. The exigencies of everyday life in school simply render infeasible those reforms that add to the already barely tolerable burden.

David Cohen emphasizes the need to keep this history in mind when predicting the reception given computers. He believes they will be widely adopted *and used* if, and only if, they "can be used flexibly, like books . . . because they could be accommodated within extant patterns of practice" (Cohen 1987, p. 155).

Given the frequently extra-educational reasons for computer purchases (the aforementioned pressure from parents and from business groups, plus the occasional teachers or administrators who champion computer use to enhance their own standing), many computers enter the schools amid no clear agenda for how they are to accomplish educational objectives. Among the teachers interviewed for an Australian study,

> there was a general belief that computers were an inevitable part of everyday life and hence that it was "good" for students to learn about them. The statements of teachers did not go beyond this level of analysis, so no clear indication was given on exactly what students should know about computers and how the knowledge learnt at school would help the students in that school to understand the "new age" or to secure a job after leaving school. (Firkin et al 1985, p. 11)

Buying computers does address the needs of school officials. Under pressure to do something, *anything*, about the economy, the supposed threat posed by international competitors, students' job prospects, and the impending information age, installing computers enables them to appear to be responding to all these assorted crises. The problem of then rendering the machines educationally useful is something else:

> The responsibility of the administration is often limited to ensuring that the equipment is there, a room found, and the timetable running well. The introduction of the computers and the development of a program around them are left to those enthusiasts amongst teachers who have initiated the innovation or who have come forward once it was proposed. (Firkin et al 1985, p. 29)

As Cohen argues, the computers are likely to be used only where they readily fit into existing practice. Given the degree of institutional inertia and the absence of a clear mission for them, it shouldn't be surprising that once purchased, a considerable number of computers sit largely unused. And disturbingly many of those in use are doing little more than automating the least adventurous kinds of instruction.

None of this, though, should be taken to mean the computers have no impact. Although for the reasons discussed they don't appear likely to trigger the transformation in schooling envisioned by their proponents, their presence and usage can still have all sorts of consequences. In one sense, if the school context shapes computer use so as largely to reinforce existing practice, that can be seen as denoting no change at all. But the reinforcement of existing practice is itself a development with very serious consequences, especially for those students already benefiting the least from their schooling. Moreover, the computer is a potent artifact, and as the next section will illustrate, even when from an administrative perspective it appears domesticated into serving preexisting objectives, it still carries a lot of baggage with it.

The Shaping of a Technology: Computers and their Inheritance

The previous section has argued that the impact of a given technology depends significantly on the context in which it is used, that the attributes built into the technology do not fully determine how it may be used and to whose benefit. Without losing sight of the variation due to context of use, I would like to argue in this section that the environment in which a technology is developed—especially the power relations prevailing there—does nonetheless instill in the technology traits that favor some uses (and beneficiaries) rather than others.[8]

The Myth of the Information Age

The ubiquitous talk of an impending Information Age suggests that benefits will accrue automatically. In an example of what I called "technological determinism" above, most of the Information Age rhetoric invokes an image

of vast improvements in civic participation and access to resources, brought about by the mere presence of new technologies. Langdon Winner lists some of the key fallacies underlying these claims in his essay "Mythinformation": (1) people are bereft of information; (2) information is knowledge; (3) knowledge is power; and (4) increasing access to information enhances democracy and equalizes social power (1986, p. 108).

To suggest that participation in public life is currently limited by inadequate amounts of information is misleading. While some specific kinds of potentially helpful information are not well distributed, on the whole people are drenched in information. The problem isn't getting enough, but making sense of what we already have; providing everyone with an on-ramp to the "Information Superhighway" won't help with that problem. Information—raw data and facts—does not amount to knowledge until it is organized somehow, shaped by an intelligence, gathered toward some end. And knowledge does not constitute ideas, let alone wisdom, until it is further digested and pondered. Ideas may in some sense be power, but knowledge is not, much less information. Ideas are what help people make sense of public events. There is plenty of raw data about, so much in fact that it inhibits our ability to perceive and grapple with the operant ideas:

> When we blur the distinction between ideas and information and teach children that information processing is the basis of thought . . . we bury even deeper the substructures of ideas on which information stands, placing them further from critical reflection. For example, we begin to pay more attention to "economic indicators"—which are always convenient, simple-looking numbers—than to the assumptions about work, wealth, and well-being which underlie economic policy. Indeed, our orthodox economic science is awash in a flood of statistical figments that serve mainly to obfuscate basic questions of value, purpose, and justice. What contribution has the computer made to this situation? It has raised the flood level, pouring out misleading and distracting information from every government agency and corporate boardroom. (Roszak 1986, pp. 106–07)

While the computer has intensified the problem, it certainly did not create it. The power of low-level facts to sway public opinion derives from a worldview of which the computer is simply the latest incarnation. "Behind the style stands the mystique of scientific expertise that lends authority to those who marshal facts in a cool, objective manner. The computer is simply a mechanical embodiment of that mystique" (Roszak 1986, p. 164).

Information is no substitute for the ideas that enable understanding of the social world. Nor does it suffice to enable affecting the world; that capacity depends more on organized action than on information. "The formula information = knowledge = power = democracy lacks any real substance. At each

point the mistake comes in the conviction that computerization will inevitably move society toward the good life. And no one will have to raise a finger" (Winner 1986, p. 113).

If information glut is useless for democratic action, it is far from useless for other forces.

> The bureaucratic managers, the corporate elite, the military, the security and surveillance agencies are able to make good use of computerized data to obfuscate, mystify, intimidate, and control. . . . These social elements have deeply rooted, long-standing interests to which information can be assimilated and from which programs can be deduced. In military affairs, they work to preserve the nation-state system; in economics, they work in response to the entrepreneurial ethic; in politics, they work to further Utilitarian managerialism. (Roszak 1986, p. 208)

It really should come as no surprise if information technologies turn out to benefit primarily the most powerful actors in society. After all, they are the ones most able to influence the development of the technology.[9]

But if the myth of the Information Age is indeed a myth, then what exactly is the cultural inheritance of computers? The network of influences on computing technology form a complex web which is explored below, clustered around issues of control and domination. Among the elements are: the separation of mind from body and conception from execution; militarism; the treatment of people as machines; the growth of a formalized mode of social organization based on structural position, not individual relationships; and a discourse of fully specifiable "closed worlds."

Technologies of Control

In principle, computing technologies could support independent action and variety as easily as centralization and standardization, but in practice the latter tendencies predominate. Typical is the story Arthur Cordell tells of a local branch manager for a bank. A new computer system gave the regional vice president immediate access to all information about the branch's operations with a few keystrokes: up-to-the-second data on deposits, withdrawals, loan payments, defaults, etc. When asked what his role was now, with all this information being delivered directly to the central office, the branch manager answered "I'll be damned if I know" (cited in Mosco 1988, p. 9).

Why should computerization so often lead to more centralized control? The key may lie in formalized symbolic representation of events in the world. Although formalized systems discard much of the texture of everyday life in their stylized representations of it, that very attribute allows them to be

applied identically across many sets of circumstances. Once any process (computerized or not) is constrained to heed symbolic directives, it can be controlled from a distance. Indefinitely many such processes can then be controlled simultaneously, be they physical (say, petroleum refineries whose operations are regulated automatically), psychological (missile launch officers instructed precisely how to respond to encoded commands), or social (government agencies following a standardized planning and budgeting system). This capacity to control operations at diverse, scattered sites with one design strongly favors centralization, with a great deal of power residing with the designers at the center—or whoever directs the designers.

This concentration of power is essentially the same as the one that accompanies a shift from oral to written literacy. The written form of a directive is amenable to being reproduced and transported, enabling exactly the sort of centralized remote control I am describing. This capacity is independent of the mechanical automatization of the computer, though certainly amplified by it. The increasing separation in the workplace of conception from execution is one clear example. The practice has been well understood at least since F. W. Taylor (see Braverman 1974 and Edwards 1979 for influential histories of this topic), but with computerized operations, ever more skill can be embedded in machinery directed by programs written elsewhere, rather than by human operators. And for production which remains labor-intensive, computing technology also makes possible the exportation of the actual labor to sites arbitrarily far from the design work, so that "a predominantly young, nonwhite and female workforce executes production which is conceptualized thousands of miles away" (Burris 1989, p. 449). This theme of an affinity for control will recur in various guises below.

Militarism and the Discourse of Closed Worlds

Computing technology in particular, and engineering in general, have long had a symbiotic relationship with the military. In one direction, many new technologies have come into existence solely because of military sponsorship, and many more have had their ultimate contours shaped by military interest; in turn, the sponsored technologies have made possible the "command-and-control" style of modern military operations (more recently, "command, control, communications, and intelligence" or C^3I). This section will discuss the influences in both directions.

Contemporary engineering education has its roots in military institutions of the eighteenth century and in reform movements prompted by World War I.[10] The development of the computer, in particular, has been driven almost entirely by military applications throughout its history (see Hanson

1982 for a full account), from the gigantic masses of wire and vacuum tubes constituting the first digital computers, brought into being by World War II, through the invention of the solid-state transistor and of the integrated circuit (silicon microchip) down to the present. As of the late 1980s, the top tier of university computer science departments—MIT, Stanford, Carnegie-Mellon, and Berkeley—drew 90 percent of their research funding from the Department of Defense (Thomborson 1987), rendering them essentially a private preserve of DoD, with tremendous sway over the research agenda of the entire field. In return, the military has gained use of a technology which is a perfect embodiment of military philosophy and facilitates its furtherance. If the computer carries an innate bias toward centralized control, as I suggested earlier, a convergence between computing and the military, which relies on rigid centralized control of dispersed components, is only to be expected (see Robins and Webster 1989, chapter 8, for a fuller discussion of this convergence).

Another outgrowth of this symbiosis is the treatment of people as machines. Since World War II, in order to cope with increasingly complex weaponry and accelerated battle conditions, military training has been based on the concept of the "man-machine system,"[11] viewing the human operator and the automated equipment as a single functioning unit. In "man-machine" thought, people are seen simply as components of some larger system, typically computer-based, and all the components (both human and mechanical) are reduced to their information processing functions. The person thus becomes an "information transmitter and processing device interposed between his machine's displays and . . . controls" (cited in Noble 1989, p. 18).

Lewis Mumford similarly credits the military with creating "complex human machines composed of specialized, standardized, replaceable, interdependent parts" (that is, armies). As this mode of organization spread through society, the entire social structure has become a megamachine "composed of living, but rigid, human parts" and devoted to control above all else (cited in Levidow and Robins 1989, p. 160).

What has thus long been true for the control of human bodies is now being extended, via more elaborate technologies, to the human mind as well. And it should be expected that computing technology, sponsored by institutions which depend internally on exactly such modes of control, would tend to function both directly and ideologically so as to propagate these rigid and standardized modes throughout society. One way this baggage is transmitted ideologically is via the practice of artificial intelligence. Since actually replicating human intelligence on a machine is such a formidable task, what happens instead is the redefinition of 'mind' down to a lower level that *can* be

imitated by machines. Roszak argues that it is typical with social applications of computer power for "a complex social phenomenon [to be] reduced to something brutally simple that falls within the province of the machine. Politics is revised to become opinion mongering; war is revised to become the calculation of velocities and trajectories" (1986, p. 208). And mind is reduced to information processing.

As a result, when computers are introduced to the classroom, they bring along a hidden curriculum of "deep assumptions about the nature of mentality":

> No other teaching tool has ever brought intellectual luggage of so consequential a kind with it. A conception of mind—even if it is no better than a caricature—easily carries over into a prescription for character and value. . . . The subliminal lesson that is being taught whenever the computer is used (unless a careful effort is made to offset that effect) is the data processing model of the mind. . . . Powerful corporate interests are at work shaping a new social order. The government (especially the military) as a prime customer and user of information technology is allied to the corporations in building that order. Intertwined with both, a significant, well-financed segment of the technical and scientific community—the specialists in artificial intelligence and cognitive science—has lent the computer model of the mind the sanction of a deep metaphysical proposition. All these forces, aided by the persuasive skills of the advertisers, have fixed upon the computer as an educational instrument; the machine brings that formidable constellation of social interests to the classrooms and the campus. (Roszak 1986, pp. 217–18)

The contemporary treatment of humans as components of a megamachine, bred by military needs and facilitated by computing technology, overlaps and converges with another longstanding trend: a shift in the basis of social organization from individual relationships to structural positions. The sociologist Dorothy Smith sees this shift to a more formalized mode of organization as encompassing several parallel changes (Smith 1993). As individuals become separable from the offices they hold, social organization becomes expressed in the relations among the offices rather than among the people who happen to occupy them at any given time. And with this shift from the particularized to the formalized, organizations rather than individuals become the repositories of knowledge and the exercisers of judgment. These observations dovetail with a concern raised earlier that systems based on formalized symbolic representation tend to support concentration of power and centralized control-from-a-distance. Similarly, Smith believes the changes she lists promote a form of social organization based on extra-local rule via "out-of-body experiences," that is, through formalized interactions detached from

the circumstances of the persons involved, as well as progressively excluding women while depending entirely on them to support the disavowed bodies of the men participating in this regime through, for instance, cleaning their offices and feeding them at home.

The original Luddites were primarily protesting an early manifestation of these changes (see Webster and Robins 1986, chapter 1). Their ultimate target was not so much the machinery they smashed (quite a bit more selectively than popular mythology suggests) as the ideological shift it expressed, from paternalistic employment to the impersonal, contract-oriented relations of liberal political philosophy. The changes they objected to did not originate in the technology, but they did see technology as "expressive of particular structures of social relations" (p. 5). As I have been arguing, technologies embody the conditions out of which they emerge and tend to reinforce those conditions wherever they are used. With reference to the specific social conditions both Smith and the Luddites decry, "technology has a general drift of denying the particularity of place, of group, or of person" (Goldhaber 1986, p. 47).

As an example of how computer use enforces this formalized, abstracted mode of social interaction, consider this experience I had a few years ago: I received a blank form from the publisher of a directory of households in my city of residence, with a request to fill in information pertaining to our household and return the form. The first line was marked "husband," the second was marked "wife," and the rest were designated for "other occupants over 18 years of age." My household at the time happened to consist of five unrelated adults. We had no husbands and no wives. I called the publisher to complain about their apparent assumption that all households contain a married couple. The person who answered the phone was pleasant but not particularly helpful. She suggested I cross out the labels "husband" and "wife," and fill in our names in any order. I asked how the information would then be entered into their database. She said that was no problem, whoever happened to be on the first line would be labeled head of the household, and we would be listed in the directory under their name. Which is to say I could cross out whatever I liked, but it would have no effect on what got into their database. I told her our household had no head, and we would not be returning the form.

Had their listings not been standardized into a fixed format with everything stuffed into an abstract set of categories, had their final product simply been a large sheaf of cards users could flip through, then I could have scribbled any sort of explanation on our card and it would remain there for users to see. But in formalizing the information in preparation for computerizing it, they conclusively imposed an ordering on it whose exclusions will not necessarily be obvious to users of the directory, who will just see a tidy list of households, organized "naturally" by name of household head.

In a similar experience during a recent job search, I received "affirmative action" forms from most of the universities I applied to work at, requesting that I volunteer information on my sex, race, veteran status, etc., so the university could gauge their success at reaching goals of diversifying their employee pool. One of the by-products of this particular method of pursuing those laudable goals is that applicants' identities are classified into arbitrary, fixed categories. For instance, one such form, under the "Racial/Ethnic Data" section, asked me to choose which of five groups I identify with [American Indian or Alaskan Native; White (not Hispanic); Black (not Hispanic); Asian or Pacific Islander; and Hispanic], noting that "we can record only one racial/ethnic choice; if more than one is chosen, it will be recorded as *unknown*." Now what if I had one Black and one White parent, or one Asian and one Black parent? Or parents who were themselves bi- or multi-racial? Or if I affiliated culturally with more than one group for other reasons? In response to the imperative to count the members of various categories and abstract the entire applicant pool into a single set of numbers, this university (like many others) formalized racial identity in a manner that excluded many possibilities and rendered the exclusions invisible to users of their data, just as with the city directory example. But what's worse, in this case an initiative specifically intended to welcome a broader range of people into an institution effectively tells many of them they don't even exist.

What is the social import of this tendency to formalize and quantify, expressed in and bolstered by the computer but not originating in it?

> Something very big, new, and threatening is permeating our political life. It makes use of the computer as its vehicle, but more important than the means is the mentality that uses the machine. . . . No ambiguities, no subtleties, no complexities. The information that data banks hold is life stripped down to the bare necessities required for a quick commercial or legal decision. *Do or don't give the loan. Do or don't rent the property. Do or don't hire. Do or don't arrest.* This is human existence neatly adapted to the level of binary numbers: off/on, yes/no. What we confront in the burgeoning surveillance machinery of our society is not a value-neutral technological process; it is, rather, the social vision of the Utilitarian philosophers at last fully realized in the computer. (Roszak 1986, pp. 186–87)

The military concern with control, the treatment of people as machines, and the shift to a formalized, structural mode of social organization all fuse in what Paul Edwards calls "closed-world discourse," which views the world mechanistically, as composed of interlocking systems amenable to formal mathematical analysis (Edwards 1989, 1996). This application of systems sciences to social systems, exemplified in U.S. military thought since World War II, tends to assume the closure of the systems analyzed, that is, the systems are