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Will computers dehumanize education? A grounded approach to values at risk

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Abstract

In this paper we examine the concern that computers will dehumanize education, one aspect of the general concern over possible threats to social and ethical values resulting from the computerization of schools. Concern over computerization of schools has become a battleground for ideological debates. Our paper does not enter this fray. Rather, we devise an alternative approach, called a grounded analysis, which addresses core concerns of practicing educators and administrators in their own terms. First we examine what people seem to mean when they worry that computers may dehumanize education. We identify four versions of this concern: that children may withdraw from people and society; that the teacher-student relationship may break down; that the teaching of important values may be jeopardized; and that education may become overly standardized. We systematically evaluate each of these concerns. Reaching no simple conclusion, we find that although dehumanization is not an inevitable consequence of using computers in education, it does pose some genuine risks serious enough to justify caution. Importantly, our analysis suggests that the actions of educators and policy makers may significantly raise or lower these risks. © 1998 Elsevier Science Ltd. All rights reserved.

1. Introduction

Many people feel uneasy about the increasing presence of information technology in schools. In part, they are apprehensive about the possible denigration of societal and ethical values as a result of computerization. Yet while these concerns are widely

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expressed and much discussed in scholarly circles, where they have become a battleground for grand ideological disputation, we find little evidence that these concerns have led to any noticeable and decisive action.

Our paper examines one aspect of the general concern for societal and ethical values: that computers will dehumanize education. We approach the problem by trying to clarify, formulate, and evaluate what people might mean when they say that they worry about computers dehumanizing education. Because of our interest in practical consequences, we have devised an alternative approach—which we call a “grounded” analysis—to the problem, that tries to understand the concern over dehumanization in the terms of those positioned to act—the educators, administrators and school policy makers. We are convinced that one important reason that decisive action has not followed the substantial works of criticism of computerization is that these works are usually not expressed in terms that are meaningful to the educators, administrators, and school policy makers responsible for bringing about change. Our grounded approach to the issue of dehumanization is an attempt to do just this.

The paper comprises three main parts. In the first, we introduce the idea of a grounded analysis of social and ethical concerns over computerization in schools and compare it with some of the existing approaches to critiques of computerization, which tend to be more abstract and ideological. In the second part of the paper, we develop a grounded analysis of the concern over dehumanization of education. In the third part, we recommend practical responses in light of findings from the second part, and respond to anticipated criticisms of our grounded analysis.

2. A grounded analysis

2.1. *Criticism without action*

Many thoughtful educators have written about the dangers of using computers in education. As early as 1969 the prominent humanist spokesman on education and former President of the University of Chicago, Robert Maynard Hutchins, warned that computers would “confirm, deepen, and prolong the life and influence of the worst characteristics of mass education [1].” Warnings about the dangers of using computers for education have continued ever since. Michael Apple, for instance, offers an institutional and economic analysis to show that the use of computers poses serious risks to education, including loss of teaching jobs, deskilling of teaching, distortion of teaching to favor the technically adept over teachers with other teaching abilities, and a curriculum that fosters a technical cast of mind and focuses on questions of *how* at the expense of a humanistic orientation that asks questions of *why*. Use of computers may also lead to the passing of control over education from teachers and parents to a techno-elite and to corporate and business special interests, and to even more severe inequalities in educational opportunity by gender, race, and class [2].

C.A. Bowers delivered a similarly severe warning based on different grounds. Drawing on the work of scholars of culture including Gregory Bateson, Mary

Douglas, Clifford Geertz, and Walter Ong, among others, he built a case that the use of computers for education fosters what he called a technicist mind-set.

The technicist mind-set privileges experimental innovation over substantive traditions, abstract and theoretical ways of thinking over implicit forms of understanding, the autonomous individual over the collective memory and interdependence of the cultural group, and a reductionist, materialistic view of reality that denigrates the forms of spiritual discipline necessary for living harmoniously with other forms of life that make up the Gaia of planet earth [3].

These and many other scholarly critics [4–11] have produced a steady stream of powerful arguments against the use of computers in education.

Educators with more practical perspectives warn of dangers, too. An issue of the *Journal of Teacher Education* included an article entitled “The Emperor’s New Computer: A Critical Look at Our Appetite for Computer Technology, [12]” which questions the value of computers for education. It attributes the widespread excitement among educators about computer technology to the pernicious influence of powerful special interests, invoking Postman’s concept of technopoly [8], a society dominated by technology, to explain pressures on schools to use computers.

In a technopoly, all aspects of human life must find their meaning in terms of the current technology. That just about describes the tenor of the situation at both the academy with which we are associated and the public schools we serve [12].

The authors end on this chilling note:

The procession is in full swing. Money and reputations are being made as the computerization of education goes forward. The process will not stop of its own accord. And this time around, we cannot count on a little child to point out the obvious. The children are in their rooms with the shades drawn staring at computer screens [12].

One might suppose that so many grave warnings from such reputable sources continued over such a long period of time would arouse concerned educators and parents to resist the use of computers in schools. Surely, if they were convinced of these dangers, teachers, school leaders, and parents would step up to defend against them, even if it meant calling a halt to the purchase of computers by schools. Individuals have taken drastic actions—the Kentucky author and farmer Wendell Berry’s celebrated refusal to use computers is a case in point—but organized resistance to the use of computers in schools by teachers, parents, or school leaders is almost non-existent. Concern, yes. Even suspicion. But active resistance, no. Resistance to national tests and constructivist mathematics teaching reforms is far stronger than opposition to the use of computers in schools. Public forums rarely feature discussions of the pros and cons of computers, certainly nothing remotely as intense

as discussions of school vouchers, drugs and violence in schools, or world-class standards of school achievement.

Meanwhile, the use of computers in schools continues to expand rapidly. As early as 1983, surveys showed that 75% of schools in the U.S. were using computers [13]. The first international study of the use of computers in schools, using data collected in 1990, showed that schools in the U.S. led the world in the numbers of computers per child, and in the variety of uses to which students in the grade eleven sample said they had put a computer in school during the current year [13]. The most recent surveys show that the number of computers in elementary and secondary schools has continued to grow rapidly over the past decade, reaching 3.5 million in 1992, considerably more than the 2.8 million full time teachers working in those schools [13].

2.2. *An absence of conviction*

What is the matter? If computers pose a danger, why doesn't somebody do something? Critics often ask this question. Pepi and Scheurman, for instance, ask "Why are those with doubts about the apotheosis of technology so reticent to voice them and so willing to act in ways that deny them?" [12]. Critics offer many explanations for this inconsistency. Some believe Americans' minds are closed to criticism of computers. Some believe Americans are so dazzled by the novelty and hype that they are unable to imagine that computers could be harmful. Some suspect a plot by powerful business interests to suppress opposition. Others believe that individuals who oppose computers feel resigned, powerless to stem the tide, their voices drowned in the overwhelming flood of enthusiasm for educational computing.

Many factors are probably at work, but to us the most convincing explanation is the simplest—educators do not resist computers because they are just not convinced enough of the actuality and seriousness of the threat. They lack conviction. The warnings make them worry, but do not convince them enough to provoke active resistance. Like most of us, they harbor questions and concerns, but are unsure about whether they really should be seriously concerned and so they shrug their shoulders and let themselves be carried along in the mainstream.

It is an understandable response. If you are not sure, you would be foolish and irresponsible to take a strong stand against a promising and popular innovation. But in effect, those who respond this way are evading their fears, side-stepping them instead of facing them squarely and deciding firmly whether they believe them to be serious or not. We would all be better off if educators and the interested public could move toward well-founded convictions, one way or another, about the risks or benefits of using computers for education. If the dangers are as serious as critics claim, responsible educators should be taking action to protect students and society against the risks. If these concerns are unfounded, educators should dismiss them and move swiftly and vigorously to realize the benefits of using computers. Suppressed worries sap energy, undermine enthusiasm, and do nothing to reduce real risks.

If the problem is lack of conviction, what is the answer? In particular, what can

scholars, researchers, and academics do to help those responsible build the conviction they need to act responsibly? More and better scholarly critiques of the kind critics have already issued will help, surely, but new approaches may also be needed. We believe that part of the reason that criticisms have failed to produce the conviction necessary for action is the way critics have gone about attempting to persuade people of the dangers.

3. Grand ideological disputation

3.1. A wrong approach to practical change

Most of the scholars who have addressed concerns about the dangers of using computers for education have used conceptual approaches drawn from philosophical and critical traditions. These conceptual approaches adopt as their starting point some systematic philosophical perspective on technology and society and then proceed to show, given this perspective, that a strong case can be made that the use of computers for education poses this or that threat. Nearly always this perspective is counter-cultural, that is, it rejects values, assumptions, and beliefs widely held within the culture in favor of other competing ones.

For instance, Theodore Roszak, in *The Cult of Information*, argues that the chief danger of using computers for education is subjugation to powerful corporate interests.

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. This model... connects with a major transition in our economic life, one that brings us to a new stage of high tech industrialism, the so-called Information Age.... Behind that transition, powerful corporate interests are at work shaping a new social order [14].

In his supporting arguments, Roszak appeals to a sophisticated and essentially humanistic view of the mind. He asks readers to believe, with him, that

[t]he art of thinking is grounded in the mind's astonishing capacity to create beyond what it intends, beyond what it can foresee. We cannot begin to shape that capacity toward humane ends and to guard it from demonic misuse until we have first experienced the true size of the mind [14].

Those readers who can bring themselves to subscribe to this theory of mind may find Roszak's case convincing, but what about the others? How convincing will this argument be to a student of contemporary scientific psychologists such as Jerome Bruner or Howard Gardner, or Vygotskians or neo-Piagetians?

Similarly, Neil Postman rests his case against the use of technology in education on a concept of cultural development that he invents. According to Postman, cultures

may be classified into three types: tool-using cultures, technocracies, and technopolies. In tool-using cultures “the tools are not intruders. They are integrated into the culture in ways that do not pose significant contradictions to its world-view [14].”

In a technocracy, “tools are not integrated into the culture; they attack the culture. They bid to become the culture. As a consequence, tradition, social mores, myth, politics, ritual, and religion have to fight for their lives [14].” Technopoly, finally, is “the submission of all forms of cultural life to the sovereignty of technique and technology [14].”

Using arguments based on these concepts, Postman points out numerous dangers of using technology in our daily lives and calls for us to become “loving resistance fighters [14].”

What we need to consider about the computer has nothing to do with its efficiency as a teaching tool. We need to know in what ways it is altering our conception of learning, and how, in conjunction with television, it undermines the old idea of school [14].

To the question “Why should we [introduce computers to the classroom]?” the answer is: “To make learning more efficient and more interesting.” Such an answer is considered entirely adequate, since in Technopoly efficiency and interest need no justification. It is, therefore, usually not noticed that this answer does not address the question “What is learning for?” “Efficiency and interest” is a technical answer, an answer about means, not ends; and it offers no pathway to a consideration of educational philosophy. Indeed, it blocks the way to such a consideration by beginning with the question of how we should proceed rather than with the question of why. It is probably not necessary to say that, by definition, there can be no education philosophy that does not address what learning is for [14].

The educator or parent who finds Postman’s ideas about culture, technology, and education compelling may well, from reading Technopoly, gain the conviction to join Postman’s “loving resistance fighters.” But how many will that be, and what will the others do who find Postman’s analysis worrisome but less than fully convincing?

In principle, speculative arguments built on counter-cultural perspectives can be immensely persuasive. New opinion leaders can use novel and stirring ideas to challenge and overthrow established ideas and gain control of schools. Once in control, they can change policies and practices about the use of technology. Most conceptual revolutions fail, however, and those that succeed do so only after decades of contention among intellectuals. A conceptual counter-cultural argument against technology offers a typical teacher-leader, principal, or school board member who acts on it a slim chance at a big payoff in the distant future and a high probability of being on the losing side of a nasty argument with local powers-that-be in the short run. We should not be surprised, then, if most of those who are responsible for school policies are not moved to bold action by conceptual counter-cultural arguments against the use of technology in schools.

Another reason why conceptual counter-cultural arguments often fail to convince

educators and parents is that they are not grounded in the concrete experiences of teaching and learning in schools and classrooms. Neither Roszak nor Postman is a pre-college teacher, and neither of them uses classroom examples in their books. While they cite dozens of philosophers, intellectuals, and other conceptual innovators, they cite no reports of events in actual classrooms or schools. As a result, readers interested in education must ask themselves whether the analysis given really applies to computers as they are used in schools and classrooms.

4. An alternative approach: a grounded analysis

What else can scholars offer? They can offer an analysis based on generally accepted ideas about technology and education, and one grounded in the experiences of educators and parents. We call this a “grounded analysis.”

The aim of a grounded analysis is the same as the aim of conceptual counter-cultural analyses C namely, to identify and describe the dangers of using computers as accurately as possible and to pin down as firmly as possible their nature, origins, and seriousness. But a grounded analysis begins with the concerns that those most directly involved actually express and the reasons they give for being concerned. These concerns and rationales are presumed to reflect their experiences as they interpret them using the ideas they prefer to use. The rationales they give for their concerns, counter arguments to these rationales, and rebuttals to these counter arguments are all considered in light of generally accepted values and ideas and the best available evidence on disputed issues of fact. An attempt is made to identify the best actions those responsible could take to guard against the threat. Finally, a grounded analysis tries to isolate conditions that call for action.

A grounded approach has the potential to engender the conviction that educators and parents need in order to act against the presumed dangers of computers because a grounded analysis does not require the reader to adopt new beliefs and values. Its arguments are based on beliefs and values already widely accepted by educators and parents. Also, a grounded analysis is based on experiences like those familiar to educators and parents—on classroom experiences and experiences in teaching and learning with computers.

Our aim here is to develop a grounded analysis for one category of concerns about computers C that they may dehumanize education. We hope that readers may be able to judge from the results of our analysis something of the potential of a grounded approach to social and ethical questions about computers and education even beyond the substantive conclusions we reach about dehumanization specifically. In the conclusion, we address some objections that may be raised to a grounded analysis.

5. Will computers dehumanize education?

Many believe that education is a peculiarly human affair. They view it as the primary means by which mature members of a society induct young people into the

social world, a world their elders have built out of what they inherited from their forebears. Education involves imparting not only the accumulated knowledge and know-how, but also the customs, attitudes, world views, and wisdom, that constitute a human community. Those among working educators themselves who worry that computers may dehumanize education fear that using computers will disrupt this quintessentially human process of education.

Philip Jackson, in, *The Teacher and the Machine*, was one of the earliest educators to voice concerns about the dehumanizing effects of using computers in education: “In human terms, mechanization refers to the process by which people are treated mechanically; that is, without giving thought to what is going on inside them” and “The gravest threat to man’s well-being, now as in generations past, is not the machine qua machine but those persons and institutions that applaud and support a mechanistic approach to human affairs [15].”

The possibility that the use of computers may lead to dehumanization continues to trouble critics of computers in schools. The program of an invitational symposium held in June 1995, “Computers in Education: A Critical Look,” sponsored by the School of Public Health at the University of California, Berkeley and the Center for Ecoliteracy, includes the following statements by invited speakers.

All projects that propose to substitute a computer system for a human function that involves interpersonal respect, understanding, and love should not be undertaken at all. (Joseph Weizenbaum)

I am opposed to the use of computers in primary and secondary education. I think their use will... de-emphasize human exchange and the forms of knowledge that go with that. (Jerry Mander)

To use computers in the teaching of reading and writing is akin to a doctor prescribing poison for a dying patient. Students need human contact; they need to hear human voices. They need teachers. (Barry Sanders)

Similar criticisms worry more than a few. If these criticisms are valid, the dangers to education are so great that responsible educators should at the very least be extremely cautious about using computers. But are the risks really that great, or have they been blown out of proportion? Are they even real, or just imagined? Are they what they seem to be, or are these critics really just suffering from an unreasonable fear of the unknown? How can anyone tell? In particular, how can educators who worry about these potential risks become convinced enough either to act with conviction or to quell their worries? Surely the first step in facing fears is to understand them. Then, we must do our best to judge how grave the risks we fear really are. But how is this done?

6. A grounded approach to the question of dehumanization

We believe that people achieve understanding through discussion and interaction—by listening, asking questions, challenging answers, responding in turn to others' questions and challenges, observing their actions, responding to those actions, offering and entertaining interpretations of words and deeds, and discussing our differing interpretations. Out of this free exchange, with effort, comes whatever understanding of others we are able to achieve.

We have set out in this essay first to understand what it is, exactly, that troubles those who fear that using computers may dehumanize education. What troubling states of affairs do these people fear may result from the use of computers and why do they find these possibilities so troubling? Once we have understood what people fear and why they fear it, we will try to assess the reasonableness of these fears. Since most fears of dehumanization are about what may happen, we cannot study the question directly until the dehumanization has already happened. Before the fact, the best we can do is to make plausible inferences. We can reason by analogy from what has happened in similar situations to what may happen when computers are used in schools tomorrow. We can look for present signs of changes that may represent early signs of worse to come. And we can examine the logic and plausibility of the reasons advanced in favor of the likelihood and fearsomeness of various dangers. This will be our approach.

The dialogue from which we have drawn our understanding has included dozens of hours of conversations with our students, colleagues, and friends, careful reading of published books and articles by those who fear that computers may dehumanize education and those who would dispel this fear, and hundreds of hours of dialogue between the two of us. As we talked, we constantly asked "What, exactly, troubles you?" "What do you think is so bad?" "Who do you think will suffer and how?" "Why do you think this problem is so serious?" "Why do you think it is likely to occur?" We accepted people's statements as valid expressions of their states of mind. Whenever possible, we challenged their statements and asked them to consider other positions. If they wavered or changed their position, we assumed that their original position had not been deeply considered. In any event, we never substituted interpretations of our own for their considered positions.

We studied in detail not only the substance of their answers, but also their choice of words and examples. We tried to bring to light the images and stories that expressed the fears as well as the reasons, beliefs, and values that sustained them.

To constitute a dialogue from the published literature, however, required a greater effort of imagination for several reasons. To begin with, although most of the fears and supporting beliefs and values we heard in our live discussions were reflected in the published literature, the authors had—perhaps with the exception of Jackson, quoted above—neither set out to answer quite the questions we were asking, nor quite as explicitly. In most cases, therefore, we had to infer how they might have answered them. Moreover, although the language used to express concerns was frequently dramatic, often referring to extreme examples, the reasons for making these dramatic statements and using these particular examples were usually not clearly

articulated. In these cases we tried to explore a number of plausible interpretations in an effort to cover the range of possible positions the authors might have taken.

As we reflected on our conversations and reading, we found that people worried mainly about four distinct possibilities that they considered dehumanizing. We refer to these as four versions of the concern about dehumanization as derived from our grounded approach to dehumanization. In effect, these represent four different stories about how it could happen that using computers in school would lead to dehumanization of education. The four versions of the concern expressed most widely were that:

1. Children may withdraw from other people and from society.
2. The teacher-student relationship may break down.
3. The teaching of important human values may be jeopardized.
4. Education may become overly standardized.

In the pages immediately following we will concentrate our attention on these four versions of the concern about dehumanization. We do not claim that they fully represent everything about dehumanization that worried critics or that should worry educators. Clearly they do not, as Jackson's concern about the neglect of inner lives demonstrates. Also, while one or more of these versions of the concern may represent a particular critic's position, all critics are not equally concerned about all versions. These are simply the versions of the concern most frequently expressed by the people we spoke to and in the literature we read. We assume that they are also widespread among educators, policy makers, and the public, and that therefore they should be addressed.

7. Understanding concerns about dehumanization

In considering these four versions of the concern about dehumanization, we begin by explaining them as critics explained them to us. Next we consider major challenges to these concerns—counterarguments attempting to show that these concerns are unfounded and not worthy of concern. We report on whatever evidence we have found that bears on the issue and try to consider it fairly and thoroughly in light of the contending viewpoints. The point of our effort is to find a sound, defensible basis for judging the seriousness of these concerns and, later, for deciding what to do about them.

8. Version 1: Children may withdraw from people

Some critics fear that computerized education may lead children to withdraw from people, not only in school but also in other areas of their lives. They fear that schools will encourage students to interact with computers instead of with other people, and that students' attention and interest will then become centered on computers, estranging them from teachers, peers, and family. This premonition is fueled by sights of children mesmerized by video games, eyes riveted to the screen for hours at a time.

But where the borders of Sega and Nintendo are clearly circumscribed within the sphere of recreation, the presence of computers within the sphere of learning would institutionalize and sanction this asocial behavior.

People who feel this concern, place high value on social interaction. They may value it for its own sake or because of the other good things to which they believe it leads, such as pro-social attitudes, social harmony, and the ability to form satisfying human relationships. Those who place less value on social interaction will not be as concerned. Also, those who feel this concern believe that it is important for schools to take an active role in fostering constructive social interaction. Others who believe that social interactions are best left to family, community, and peer group and should not be high priorities for schools will not be as concerned.

Those who feel this concern suggest several ways that social withdrawal might result from using computers in school. Children who work at computers much of the day may simply lack the time and opportunity to learn social skills. When students interact with others in school, they learn to deal with people, while “programming a computer does not necessarily teach people how to get along better with each other [16].” In addition, children who are socially awkward may find social interactions less rewarding than activities with computers.

Interacting with other children and teachers in school can be erratic, awkward, threatening and painful. Risking public failure, sharing things and attention, working together, and cooperating in groups, are always challenging and often frustrating. Interacting with computers is not disappointing in precisely these ways, though it can be in other ways. Some children will surely find the challenges and frustrations of dealing with computers preferable to the challenges and frustrations of social interaction. A slight initial preference in this direction could easily develop into a settled personality trait, as initial avoidance of social interactions reduces opportunity to learn crucial social skills and attitudes, making further social interactions still more painful.

Sherry Turkle, in *The Second Self*, contends that computers offer people a new compromise between loneliness and fear of intimacy which she calls a “schizoid” compromise [17]. Once, before computers, people who feared intimacy so much that they avoided other people had to endure loneliness. Now they can have a sort of ersatz companionship via the computer. Tittnich and Brown note that technology offers students the possibility of feeling potent while remaining in social isolation and worry that

children who have found the significant adult in their lives to be unresponsive to their needs and their cues may withdraw from interpersonal confrontation and turn to machines for gratification, essentially giving up on humans [18].

Children could also withdraw from social interaction because they compare people unfavorably to computers and therefore devalue people. Turkle points out that the computational model of thinking is yet another blow to humanity’s sense of our own unique and central place in the universe.

Before the computer, the animals, mortal though not sentient, seemed our nearest neighbors in the known universe. Computers, with their interactivity, their psychology, with whatever fragments of intelligence they have, now bid for this place [17].

Students who are impressed by the power of computers may come to regard humans as puny, insignificant creatures. Turkle quotes a distinguished computer scientist who expresses such a view:

Humans are okay. I'm glad to be one. I like them in general, but they're only human.... The mere idea that we have to be the best in the universe is kind of far-fetched [17].

Some children, convinced that humans are not "the best in the universe" and that computers are better at revered accomplishments like logical thinking, may cast their lot with computers.

Who would be harmed if children withdrew from social interactions for any of these reasons? The children who withdrew would lose the satisfactions available from socializing and the tangible and emotional benefits of having a social support network. Hard, scientific evidence seems to show that social support plays a vital part in maintaining psychological well-being and even health and longevity [19]. Others who do not withdraw from people will also suffer harm from having to live in a world where a significant number of people care little about getting along with them and lack the skills to handle awkward or difficult social situations. A large pool of socially limited individuals could even interfere with the deliberation and negotiation about important social issues needed to sustain a democratic social order in a complex economic, political, and social environment.

How likely is this? Critics point to signs that some students already show a preference for working with computers. For instance, students in one computer education program in New York public schools are quoted by researchers as saying they liked to use computers because: "My mistakes aren't embarrassing"; "It doesn't talk back"; "It doesn't yell at me"; "It calls on me every time [20]."

One of the attractions of computers for these youngsters seems to be that computers are less socially demanding than teachers. If so, it seems plausible to suppose that working more with computers might produce children who preferred working with computers to working with people and who were less skilled at dealing with difficult people.

Let us turn now to consider challenges to this concern. The strongest and most direct challenge to this concern is to deny that computers foster social isolation. Barrett (1992), for instance, argues that computers are "sociomedia."

The work we do in and outside the classroom involves people reading and talking and writing to each other in order to synthesize their thoughts.... This process is a highly social one and computers can be used to support and enrich these social interactions resulting in the discovery of public and private knowledge [21].

The environments where students use computers—school classrooms and computer rooms—are active social settings. Students help one another, discuss strategies, and often work together on computer projects. If working with computers is itself a social process and if it takes place in a highly social environment, then fears that social isolation might result from the use of computers would be unfounded.

To some extent, differing positions on this issue may reflect differing ideals of social life. Various people and social groups have different ideas about how much and what kind of socializing is healthy or pathological. Some may be content with an educational environment where many students are quiet, reserved, and often involved in solitary pursuits, while others may view such an environment as socially impoverished. Those who have a more modest or limited vision of the ideal social environment may well find that the kind and degree of sociability found when students use computers is perfectly satisfactory, while others who expect more may be dissatisfied.

But even critics who insist that work with computers leads to an unacceptable degree of social isolation can be challenged on the grounds that their concern, though valid in principle, is blown out of proportion. Schools already assign students to do many activities that draw them away from social interaction, like reading, writing, seatwork, and homework. The impact of computers on social interaction must be compared to the effects of existing practices that also tend to isolate students. Perhaps using computers in school does discourage students from socializing with other students, but does it do so significantly more than present school practices?

Both these challenges raise questions about the real effect of using computers on the social life of schools and classrooms. What evidence do we have on this question? We know that computers are used in different ways and for different purposes in schools. Some computer applications are highly social, like a science class using e-mail to share data as part of a collaborative global investigation of acid rain. Within these classrooms students work together to collect and report their data, and then they collaborate over long distances with other children as they exchange e-mail messages about their findings. In contrast, other computer applications—like educational games, drill and practice programs, programming, and word processing—are mainly used by individual students who work alone at a computer.

A summary of available nationwide data prepared by the Office of Technology Assessment in 1995 indicated that “the most common activities on computers for elementary students have been drills in basic skills and instructional games [22].” Keyboarding and word processing are also widely taught. All these programs are designed to be used by single students working alone and, as typically used, do not encourage social interaction. In high schools, computers are used primarily to teach word processing, office skills, and programming. In a 1992 survey summarized in the OTA report, only 9% of students reported using computers ten times or more per year in an English class, 6–7% in math classes, and 2–3% for social studies and science classes. The best evidence suggests that, for the most part, students in both elementary and high schools are using computers individually (or in pairs when schools do not have enough computers to go around) and using them to learn how

to use computers. This evidence tends to confirm critics' fears that using computers in school may lead to social isolation.

But does even the solo use of computers actually have the effect of increasing social isolation? Empirical studies of social interactions in classrooms where computers are used reveal a complicated and sometimes surprising relationship. Most of the studies find that in classrooms where computers are used, student-student interactions actually increase and so does student initiated talk with teachers [23–31]. Apparently, students engage in more social interactions when they use computers. Teacher talk, by contrast, decreases, especially teacher-initiated talk directed to the whole class. Sills, for instance, studied teacher-student interactions in an inner-city middle school enrolling largely poor, African American students and compared their interactions in a computer lab to their interactions in their regular classrooms. Sills concluded that

The concern... that computers would interfere with personal contact among teachers and students did not hold true. Even with some teachers actually leaving the lab, more intimate contact among teachers and students was reported in the computer lab than in the classroom [29].

Light, reviewing research on collaborative learning with computers, also concluded that we have little to fear.

The worrying image of the socially isolated and withdrawn learner, usually seen as an adolescent hunched over his or her (typically his) computer for hours at a time, still has considerable currency. However, the reality in most cases seems to be very different, both in and out of school. For example, a group of French sociologists have described the rich social culture of the computer clubs and informal, out-of-school networks of computer enthusiasts which have grown up around one French secondary school of which they made an intensive study. They point out that in many ways these groups and networks resembled very closely those which had grown up in the same school around a shared interest in rock music, or in motor cycles [32].

In short, existing empirical research seems to suggest that using computers in school actually increases social interaction, even though students are usually given individual assignments and assigned to use programs designed to be used by one student working alone. Apparently this happens because students interact more with one another and with the teacher when using computers than when listening to the teacher talk to the whole class. It seems unlikely that such a change in classroom practice could breed social isolation.

Does this mean that concern about computers leading to social isolation is misplaced? Not necessarily. Only a few studies have been done of social interaction in classrooms, and most of these have lasted only a few weeks. These data come from students for whom the computer is new and rare. Perhaps the next generation of

students, familiar with computers at home and supplied with a computer of their very own in school, may find less reason to talk to one another. Schofield cautions that

the emerging consensus that computer use tends to increase peer interaction and to foster cooperative behavior may be premature. This study suggests that a number of factors... work both singly and in combination to shape the way computer use influences peer interaction patterns [31].

Studies also find that students in computer classrooms mostly talk about how to use the computer. Students who spend much time in school talking about computers may still be unprepared for more complex and demanding social situations. It may well be, therefore, that, while using computers raises the gross rate of interaction among students, it also makes those interactions less socially meaningful.

How seriously should educators take this concern? The severest critic will be hard pressed to find evidence of a clear and present danger of serious harm to large numbers of students, but many educators may find cause for continuing concern. Some students who are particularly prone to withdraw from social interaction and particularly attracted to computers are probably already at risk of delayed social development. More students may become at risk if schools expand the use of computers beyond the current average of an hour a week or less and if schools continue to assign students to mainly individual work on the computer.

As the number of computers in schools increases, solo use of computers may well increase. Some new ways of using computers, such as distance learning, threaten to reduce direct social interaction drastically and this may increase the risk of social withdrawal. Still, when all is said and done, it appears that at the present time those who are concerned about limited social interaction in schools should worry at least as much about the rules and routines of classrooms that are already stifling social interaction to such an extent that many uses of computers, even those that seem most obstinately asocial, actually permit more social interaction to take place.

This conclusion must be regarded as extremely tentative and preliminary because it rests on sparse, weak evidence. We need to know much more about the impact of various ways of using computers on social life in schools and classrooms and on the social lives of students and graduates before we can reach a firm conclusion that would satisfy reasonable people on both sides of this issue.

Perhaps the most important finding of this analysis is an indirect, unintended one. Our analysis suggests that those concerned about social withdrawal focus their attention on a few key characteristics of computer use: the amount of time students spend with computers, how much of this time they spend in individual work, and how much social interaction is constrained when using computers and in other parts of the school day. These are, in effect, prime indicators of potential risk. As these indicators rise, concerns about the risk of social withdrawal should rise, and as they fall, concerns should subside.

9. Version 2: The student-teacher relationship may break down

Some critics see computers in schools as a threat to an important human relationship, that between student and teacher. They fear that computers will displace teachers from their respected place at the hub of classroom activity where they serve as the social and intellectual leaders and the ultimate arbiters of both academic standards and standards of good conduct. These critics look with dread on a time when computers may take over important functions now performed by teachers such as advising students on what to study and grading the quality of their work. Olson, for instance, cautions: “While computer enthusiasts may talk of more and more powerful computers, we ought to worry about more and more powerful teachers [33].” As computers are increasingly deployed for instructional purposes, critics like Olson fear that teachers may be relegated to less powerful roles, becoming mere facilitators, attendants to the primary educational transaction which will center on the computer.

In relation to this concern, two issues seem critical. One is whether the student-teacher relationship will be harmed, weakened, or threatened by computerization of schooling. This we can think of as a consideration of fact. The second, we can think of as a concern over value and it is this: If the student-teacher relationship is harmed or weakened, do we care?

We begin with the second of these two concerns and ask whether and why we should care if computerization weakens or harms the student-teacher relationship. Although ideally we would answer this concern with a full characterization of the role and function of teachers and their contribution in the present day educational system, this takes us beyond the scope of this paper (and our expertise). Instead, we note that the contribution of teachers goes well beyond conveying knowledge and helping develop skills.

Teachers motivate, even inspire students to learn, guide their learning, and advise them on academic and social decisions. Except for parents, teachers are often the adults who know children best and, indeed, an astute teacher may serve as a rich informant for parents. Teachers serve as a social and emotional bridge for children in their passage from the intimate world of the family to the impersonal public world. They are the first representatives of society at large that a child encounters often enough to know them as human beings. And, importantly, this first relationship with adult authority outside the family is centered on learning. Furthermore, teachers serve as role models for students. For less-advantaged children, teachers may be the only models of well educated persons they encounter closely and regularly.

For these reasons, some would argue that human teachers are critical, because although computers may succeed in some limited aspects of teaching, such as in developing skills and conveying knowledge, in others, the human face of teaching is irreplaceable. Lost to students would be the educated person who knows them personally and on whom they can model their conduct and the subtle but important privilege of associating with a respected adult. Also lost would be the teacher’s power to motivate students. Children will find themselves in the charge of a semi-skilled computer attendant rather than a respected, broadly educated professional. Attenuation of the role of teacher may lead to alienation from other adult authority

and even from society generally. With the downsizing of teacher role, education loses its human face.

Another loss that may follow the demise of the full-fledged teacher role is educational accountability. For many who experience school as an inhuman bureaucracy, teachers serve as the human face of a school. When parents or children perceive problems, either with the school or with the progress of an individual child, a teacher is the first alert as well as the first person to whom they turn for answers, for accountability. Most teachers consider themselves full-fledged professionals who take direct responsibility for their activities and the outcomes of their activities. If the teacher's role is diminished and weakened, however, accountability may diminish along with it. Where computers are responsible for teaching and evaluation, to whom do questioners turn, who answers for the quality of education? Even though computer systems are built by humans, the connection between these authors or designers of systems and individual students is hopelessly remote and complicated, and the responsible parties are far less accessible to parents and the public. If schools replace teachers with computers, we are left with an unresponsive, mechanized system of education.

Even if we agree that a weakening of the role of human teacher would be a significant loss, we must return to the question of fact: Does the use of computers in schools threaten to undermine the student-teacher relationship? Will computers displace teachers? Can they affect a healthy student-teacher relationship?

Resolving these questions calls for both analysis as well as supporting empirical evidence. We find that while neither are decisive, they both are suggestive. By analysis, one might argue that to the extent the computer frees the student from dependence on the teacher, it diminishes the teacher's importance. When the student's learning is controlled by a computer instead of a teacher, the teacher loses influence over students' learning. In addition, students' respect for teachers could be undermined if they were to see computers as more competent and trustworthy than teachers. Students may come to view teachers as weak, fallible and idiosyncratic and computers as strong, reliable and unflappable. Yet supporters of computerization might counter that machines can no more substitute for a qualified teacher than can a library full of books.

Although no empirical work that we found addressed the questions of how computerization affects the teacher's role, or how it affects the student-teacher relationship exactly as we pose it here, some findings are suggestive. One is a study by Hess (1970), which shows that computers can compete successfully with teachers as authorities on academic knowledge [34]. In this study, elementary school students who used computers daily to study spelling and arithmetic said that they would believe the computer over the teacher if the computer gave one answer and their teacher another. It remains to be seen which parts of a teacher's role computers can perform well enough to command students' respect, but it is plausible to suppose that role competition could arise and would interfere with student-teacher relationships.

On the possibility that computers may pose role-competition for teachers, Sherry Turkle's works offers suggestive findings. In *The Second Self: Computers and the Human Spirit* [17] as well as her more recent book, *Life on the Screen* [35], she

argues that the relationship children form with computers is different from that with other inanimate objects and resembles more closely their relationships with other humans. She claims that “the computer, unique among machines, is ”a psychological machine [17],” and that it invites comparison with the thinking activities of people. She notes that people talk about computers in psychological terms. She reports that many of the children she interviewed believed that computers could think and some even thought that computers were alive. The main difference these children saw between computers and people was that people had feelings and computers did not. Turkle concludes that “computers change the way people think—especially about themselves [17].” This line of thought, supported by her interviews with children, suggests that computers are different from the books and other objects children encounter at school and at home. Children are more likely to see computers as thinking beings like people.

In a similar vein, the social scientists Byron Reeves and Clifford Nass have conducted dozens of studies of how people respond to computers. The subtitle of their book—“How People Treat Computers, Television, and New Media Like Real People and Places”—aptly expresses this conclusion [36]. They tested many of the findings in social psychology about how humans perceive and interact with other humans and found that most appear to hold for how humans interact with computers. People react to computers as they react to people. They are offended, for instance, when computers do things that would be offensive if humans did them, like terminating the interaction without notification (say, by freezing the screen or blanking it) or intruding uninvited when a person is absorbed in a task, or giving commands that would be inappropriate for one stranger to give another (like “Press Return Now”). And people treat computers the way they treat other people, showing them courtesy, flattering them, and maintaining appropriate interpersonal distance. Reeves and Nass contend that these responses are hardwired in our brains. As they see it, over the last 75,000 years humans have evolved tendencies to respond preferentially to social cues in the environment, and any entity that exhibits sufficient interactional complexity elicits these tendencies. Again, the conclusion seems to be that people’s relationships with computers are special, more like their relationships with other people than like relationships with books or other things.

While these findings suggest that computers may be a compelling draw on students’ attention, we believe that whether computers interfere significantly with the student-teacher relationship, or pose significant role-competition to teachers, is likely to depend on a number of other concurrent factors. If teachers, for example, manage the use of computers, using them when and as they see fit, it seems unlikely that computers would adversely affect the student-teacher relationship. But if schools use computers to do valued tasks that teachers do now and would like to continue doing, then computers will be in direct competition with teachers for students’ attention and regard. If both teachers and computers present new ideas to students, for instance, some students will surely prefer the computer’s presentation to the teacher’s, and this could affect their regard for the teacher and thus weaken the relationship. If both computers and teachers test students and assign grades, students would compare their experiences in both cases and some might opt for computers over teachers.

While the possibilities mentioned above invoke considerations of psychology—social and educational—another factor that we think will be critical to the fate of the student-teacher relationship and the role of teacher is educational policy. Advocates of computers in education tout the possibilities for improved productivity. They foresee strong economic incentives for school authorities to substitute computers for teachers. Pressures to reduce the cost of education might well lead politicians and the public to “substitute capital for labor.” In times of budgetary pressure on publicly funded social projects, one can imagine school officials, bent on cutting costs, replacing qualified teachers by computers or by lesser qualified, less expensive aides supplemented by computers, or simply raising the size of classes and expecting computers to take up the slack. In every other industry where computers have been used, they have replaced human workers, and though other jobs have also been created, the original jobs have disappeared. And, since teachers will in fact be less important when the children are absorbed in working with a computer, why pay an expensive professional merely to monitor work done largely on computers?

Of course, if teachers were eliminated from the education system or if their power, status, and influence were greatly reduced, then student-teacher relationships would certainly suffer.

How seriously at risk is the student-teacher relationship? At the present time computers are used so little, for such a limited range of teaching tasks, and usually under strict authority of the teacher, that the risk of role competition seems remote. But if schools ever do begin to substitute computers for teachers then student-teacher relationships are lost altogether. If schools keep teachers but use computers in ways that relegate teachers to a less consequential role, then the role models presented to students will be less impressive, and the personal accountability of a full-fledged professional role will be attenuated.

The key indicators of risk to the student-teacher relationship seem to be: reduced exposure of students to teachers, less favorable student perceptions of teachers, erosion of the importance of the role of the teacher, role conflict between computers and teachers, and lack of teacher control over the use of computers. As these indicators worsen, concerns about the student-teacher relationship should rise; as they improve, concerns should ease.

10. Version 3: The teaching of important human values may be jeopardized

Those who worry about a lapse in the teaching of values believe deeply in the importance of a core set of shared social and cultural values. For them, all that is humanly important depends on the continued vitality of these values. They believe that keeping these values alive in young people requires explicit attention and a great deal of time and effort. In their view, these values do not emerge naturally as children mature, nor are they learned simply by growing up in the culture, like the mother tongue. Rather, these values must be instilled by institutions such as family, church, social organizations, the mass media, and, most especially, schools. Children spend a great deal of time in schools. Schools are a nearly universal common experience,

one where people of different religious faiths, ethnic origins, and political traditions learn together. What children encounter in school has a profound importance in shaping common societal values.

The teaching of values has always been an important purpose of schooling. Although we tend to think of traditional education as consisting of the Three Rs, schools in the U.S. have always taught ideals of character and conduct, too. They teach these ideals explicitly by preaching on religious and moral themes, by assigning readings with a moral, and by example in their rules and discipline. Most public schools no longer preach religious and moral values openly, but they still teach such secular values as honesty, respect for property, diligence, sobriety, nonviolence, conservation of natural resources, and responsible citizenship. Much teaching of values in schools is also done implicitly, as part of what is sometimes called the hidden curriculum. Students learn through day to day life in classrooms to share, take turns, listen, respect the opinions of others, and reconcile conflicts with peers and authority figures [37]. In so doing, they learn by experience the actions and feelings associated with larger values, such as democracy, justice, liberty, and equality. In these ways common schooling fulfills an historically established purpose to educate students from diverse cultural and socioeconomic backgrounds toward shared American ethical, social, and political norms.

Those concerned about this version of dehumanization fear that computers will interfere with the teaching of these values. Some critics maintain that computers are inherently incapable of teaching values. They argue that computers are designed to solve problems that can be codified in precise rules, and are therefore inherently unsuited for dealing with ambiguities and exercising judgment. They fear that students trained with computers will eventually come to see codified rules as the model for all kinds of learning and will disregard or deprecate values. They may even come to see all values as mere matters of opinion to be decided by each person according to their personal preferences. Some also fear that schools where computers are widely used may give less weight to value-laden content like literature and history and to goals that cannot be expressed computationally, like judgment, intuition, creativity, or integrity.

Many fear that students who spend more time on computers will have less time to spend learning human values. Using computers would, for instance, reduce the time available for the human encounters that make the values manifest. Values become real only when we face a choice or conflict with moral dimensions. School brims with such situations—opportunities for cheating, for cooperating or withholding cooperation, for being one's brother's keeper or looking out for number one. Many fear that students absorbed in computers will face fewer such situations. Also, using computers changes the nature of classroom activities, focusing them more on technical matters and less on people and deeds, and therefore leaving school activities poorer in moral content. Finally, computers may implicitly teach other values that we do not want to teach. For instance, playing games with serious subjects on the computer may lead students to develop habits of carelessness, persistent attitudes of gamesmanship, and a decreased sense of responsibility for the real consequences of their actions.

Who would be harmed if computers jeopardized the teaching of values? Presumably a life lived according to sound values is more worthwhile, and so children who failed to internalize these values would suffer. The rest of us would also suffer from having to live in a society less infused by these values. We hear calls for greater civility in public discourse and for a rededication to family values. Were schools to reduce their contribution to the teaching of values, this problem would surely worsen. Widespread failure to acquire basic social and moral values would widen and worsen conflict and might overload and incapacitate basic institutions like the courts. Failure to sustain these values would break centuries-old cultural traditions and introduce social and institutional instabilities whose consequences would be impossible to foresee. For instance, if the implicit teaching of values in public schools is a major force for social and national cohesion, as some experts claim [38], then less teaching of values in schools could undermine national unity. Some even worry about the fall of Western civilization.

Critics believe that these fears are reasonable. It is likely, they feel, that using computers would impair schools' ability to teach values. First, the teaching of cultural subjects already receives much less emphasis today than formerly. Religion, art, and music were once full subjects in the school curriculum and devoted largely to teaching generally accepted ideals and values. Now what little remains of these subjects in the school curriculum is taught to convey information and develop skills rather than to teach values. Computers would accelerate this trend. The implicit teaching of values that schools do today could easily slip away with little fanfare because it is all done off the official curricular books. The explicit teaching of values is always a potentially volatile topic in a diverse, multicultural society, and computers are likely to be seen as morally neutral, uncontroversial, and hence safe. Those who want to avoid controversy might well turn to computers with relief precisely because they believe that computers could not be used to teach controversial values.

Champions of computers challenge the validity and seriousness of this concern in several ways. Some challenge the contention that computers are inherently incapable of teaching values. Some insist that the use of computers need not interfere with the teaching of values. They assert to the contrary that time spent working with computers can be used effectively for both implicit and explicit teaching of values. Some question whether schools really teach values effectively. If not, then using computers would incur no loss. As a last resort some argue that, even if there is a loss in the teaching of values, this could be more than compensated for by improvements in other aspects of education. We turn now to examine these challenges.

Most who advocate the use of computers in schools deny the charge that computers are incapable of teaching values. They point out that books—inanimate objects produced and distributed by industrial methods—are used to teach values. Computers offer sounds, moving pictures, and interactivity in addition to text and pictures. Why could they not be used to teach values even more effectively? They point to computer-based teaching materials such as the CD-ROM *A Right to Die?* The Dax Cowart Case, as examples [39]. This computer-based case, designed by the Center for the Advancement of Applied Ethics at Carnegie Mellon University for use in college courses in ethics, raises profound questions about who has the right to deter-

mine whether a seriously injured person can be allowed to die. It includes interviews with the injured person and his physicians and relatives. It provides a wealth of detail about the injured person's background and life prior to and after the accident, the extent and nature of the injuries, treatments administered, physicians' opinions, etc. It contains a teachers guide that offers tips on using the CD-ROM several different ways in teaching, including Socratically-guided inquiry. This and similar products, advocates claim, demonstrate that computers can be used to teach values.

The belief that computers are inherently incapable of teaching values is plausible only if we imagine that the computer's role will be that of a human teacher. But if teachers use computers to create a rich environment for the discussion of value questions then clearly computers can be helpful in teaching values. If books can be used to aid in teaching values, then so can computers. While it is true in principle that a medium may constrain and distort our messages and therefore our thoughts and actions, this medium seems at least as capable of being used to teach values as books, and we found no critics who charged that books are inherently dehumanizing.

But what about the implicit teaching of values as part of the day-to-day life in classrooms? Advocates of computing argue that the same kinds of social difficulties and dilemmas arise when students use computers in schools and classrooms as arise when students study in any other way. Situations still arise in computer-based teaching environments that call for demonstrating and teaching virtues such as helpfulness, honesty, sharing, and respect for the rights of others. As long as schools continue to teach students in groups, opportunities for conveying values will still arise, even if they are not identical to the opportunities found in classrooms without computers.

The strength of this challenge hinges on two empirical questions: Do opportunities to confront important value questions arise as often when students use computers as when they engage in other school and classroom activities? Do teachers or other adults assume an active role in helping students confront and resolve value questions when students work on computers as they do in other classroom situations? We do not really know.

It seems likely that opportunities to confront value questions would be similar when the computer is used as an integral part of an English or social studies class, but we know that most computers are located in special computer labs and that what students mostly do with those computers is learn how to use them for practical tasks such as writing, typing, accounting, or programming. Computer classes may well present fewer opportunities to raise significant value questions than do classes in social studies or English, but would a programming class present fewer opportunities than a math class? And would a teacher of programming be any less likely to seize whatever opportunities arose for teaching values than a math teacher? Probably not, but we don't really know. If using computers means teaching more scientific, mathematical, and technical content and less content from the humanities then there may well be grounds for concern.

Similarly, we lack a solid base of information to judge whether computers may implicitly teach other values that we do not want to teach. We do not know, for instance, whether students who destroy a virtual city on the computer will become

more violent or have less respect for life. Until we know, educators have cause to worry.

Some challenge concerns about the effect of computers on the teaching of values in schools on the grounds that schools do not really teach values, anyway. They maintain that schools are mainly academic institutions for teaching the skills and content needed for success in a complex society, and that the relatively minor amount of preaching and enforcement of rules that schools do has little impact on the teaching of values. They believe that families, peer groups, and the media are more powerful agencies for teaching values. The charge that schools are failing to teach important social values is frequently heard in recent years, but others maintain that schools are and always have been effective socializing agencies [38]. A great deal of contemporary discussion centers on this question, especially in light of the incidence of violence in troubled schools. Resolving this issue one way or the other, although outside the scope of this essay, would significantly influence the related conclusion about the effects of computerization on imparting values in schools. Even if it should be shown that schools were ineffective at teaching values, however, many critics would insist that schools should be teaching values and, if they are not, that we should change that, not abandon the effort to teach values.

A few advocates are willing to concede that computers are not good at teaching values, but they maintain that lost opportunities for teaching values can be more than compensated for by other gains from using computers, such as improved academic learning. This argument asks educators to choose between two independent goods without telling them why they should prefer one over the other. Why is increased academic learning better than the lost opportunities to teach important social values? Until advocates of computing in schools make a compelling case that computing's other benefits outweigh lost opportunities to teach values, many will hold the teaching of values to be more important.

We conclude, then, that concerns that computers may jeopardize the teaching of values cannot be dismissed. True, the charge that computers are inherently incapable of teaching values seems to have little merit. Concerns about computers interfering with implicit modes of teaching values and implicitly teaching undesirable values may or may not be justified; we do not know enough about the effect of using computers on classroom interactions. Concerns about the teaching of values would seem to be most justified when students work on the computer in separate units or courses focused on purely technical learning. Use of the computer as part of academic experiences in English, social studies, or other academic subjects could also pose a threat to the teaching of values if it causes students and teachers to focus on narrowly technical learning instead of more value-laden goals and content. Finally, we note the link back to the issue of the teacher's role in observing that an involved teacher may guide classroom attention toward questions of values, even when computerized learning, left alone, may naturally lead attention away from it.

11. Version 4: Education may become overly standardized

Another version of the concern about dehumanization that worries many people is a rigidly standardized system of education that, in pursuit of laudable goals such as efficiency and equality, treats students as so much human raw material to be molded to standard specifications. Their nightmare is that schools will become “McSchools,” and a rigid standard program will overwhelm the many individual, family, ethnic, religious, community and regional influences that humanize the present educational system. Where teachers may see a child with a unique identity and biography, and a distinctive pattern of abilities and desires who is a member of a particular family and community, who should be encouraged to develop in unique ways, the computer will register only a matrix of numbers, a pattern of performance on pre-set objectives.

Those who are concerned about over-standardization value diversity, liberty, individuality, and the preservation of regional, religious, ethnic and cultural identities. They prefer local control of education and oppose centralization of power. These values are deeply rooted in American history and in Western cultural traditions. They, or values deeper still, are the source of the horror we feel at the prospect of anything that threatens our individuality, depicted in such science fiction thrillers as *The Stepford Wives*.

Those who raise this concern maintain that the forces promoting standardization throughout modern society are already great and growing. They include, for instance, improvements in transportation and communication, growth in the economic power of multinational corporations, and the increasingly global economic system. As critics see it, standardization of education has already progressed far in the past two or three generations, and computers will enable it to go farther, faster. Already schools feel enormous pressures to adopt common national goals that are said to make American schools more competitive with those of global competitors. Critics fear that computers will fit all too well with this movement toward educational standardization.

Some believe that standardization is inherent in the technology which simply has limited capacity to recognize, respond to, and foster individuality. Keyboards, mice, and joysticks, for instance, offer a narrow expressive palette in comparison to the crayons, pencils, paint, cloth, scissors, paste, and so on, found in the kindergarten supply cabinet. Thus, critics charge, students and teachers are forced to adapt to computer technology rather than the other way around.

In addition to rigidities inherent in the technology, standardization may also follow from its mode of production. Complex computer systems are expensive to produce and difficult to track and manage. Already, most computer software is produced by a few dominant multinational corporations, and the best bet is that educational software will be, too. When large multinational corporations like Microsoft, McDonald's, and Walmart dominate markets and drive out small, local competitors, choices narrow to a few standard options. Metaphorically speaking, corporate dominance of the production of educational technology may limit the educational menu to hamburgers and pizza. In every other industry, standardization increases when computers

are introduced. More standardization in computers, fast food, or household goods may be an acceptable price to pay for economies of scale, but in education something precious would be lost.

The strongest challenge against this concern is to assert that nothing about computers inherently promotes standardization. People may use computers either to promote standardization or its opposite. Critics maintain that using computers in schools will lead people to accept a greater degree of standardization than they would have chosen otherwise. Advocates argue that our technologies never force us to do anything against our will. Computers may make it possible or easier to standardize the curriculum, but schools may still choose not to use computers in this way. They can just as well use computers to foster curricular diversity. For instance, schools have used computers to help preserve a rare and endangered native language or to compile original sources on local history or the local economy. Similarly, schools can use computers to expand standardized testing, but they may also use them to develop new forms of assessment intended to be more realistic than paper and pencil tests for some goals.

Strong arguments can be made on both sides of this issue. It is difficult to know what evidence would help us predict the direction, let alone the magnitude, of any standardizing effect on education from computers. The argument that standardization is inherent in the technology simply because it has limited capacity to recognize and respond to varied human qualities can be countered by the argument that computers can respond to these qualities in new and powerful ways. Computers can monitor students' responses in unprecedented detail and use that data to make split-second calculations using complex algorithms to select the best learning exercise for each student. It seems that the computer is unsurpassed at individualizing within the borders of the data it can use, but those borders are narrow. Although the borders seem to be expanding, it is impossible to predict how rapidly they may expand. Therefore it is unclear how much computers may eventually affect the school's ability either to impose a standard program on all students or to adapt programs to students' individual characteristics.

Many critics are attracted to an historical argument claiming that technology always promotes standardization. Careful historical studies, however, generally show mixed effects from widely used technologies. For instance, when telephones were new, critics argued that they would strengthen the boss's hand and lead to more centralized control of the workplace. They reasoned that the boss could use telephones to give more and faster orders to managers and workers in distant sites. But telephones also permitted those in the field to communicate with one another without the bosses' knowledge, and so the net effect of telephones on centralization of power in organizations was negligible [40]. Similarly, many recall the rigidity of early consumer applications of computers ("Do not fold, spindle, or mutilate"). Yet now computers allow direct mailers to tailor mass mailings with individual names and buying profiles. There is room for argument about whether this is, on balance, an advance, but it is certainly less standardized.

These questions direct our attention to the locus of decision-making about the use of computers in schools and to the relative power of producers and consumers of

educational computer systems. If the same people make decisions about using computers as now make other educational decisions, and in the same ways, and if those decision-makers have as much access to relevant information about computer systems as they do about conventional educational materials, then they should be able to make decisions that reflect the will of the community about how standardized education should be. But people might find themselves with more standardization than they want if decisions about computers are made by more distant decision-makers, such as technical experts, school district officials, state and federal agencies, and corporate executives. Over-standardization could also come about if local educational decision-makers lack the information or background knowledge to make an informed decision about technology. They might then make choices that would lead to more standardization than they would have chosen had they known all they needed to know.

That concerns about standardization would lead us to concern over the locus of decision-making and the relative power of producers and consumers is a surprising twist that brings the discussion back to a concern about accountability that arose earlier in connection with the teacher's role. If introducing computers into schools changes the way decisions are made or who makes them, then ways must be found to assign accountability in the new system or else existing protections will be weakened. This is especially problematic when decision rules are programmed into computers that assign scores to students that are then used to award or withhold educational opportunities. Without safeguards, the present relatively transparent and accessible educational system could be transformed into an impenetrable black box that offers parents, students, teachers, and school officials only one choice: take it or leave it.

The risk of over-standardization is greater when local school decision-makers lack the competence to make informed decisions, when different persons make decisions about computers or use a different, less accessible process, when education's clients lack access and rights of appeal to decisions relating to computers, and when computer systems make decisions about students using algorithms which are inaccessible or unchallengeable.

How great is this risk for schools in the U.S.? How often do teachers, principals, and school boards make their own decisions about the use of computers, and how often do they defer to experts? When local educators make the decisions, how well informed are they? When they seek expert advice, do they insist that the experts explain their recommendations sufficiently to empower the local educators to make an informed final decision? How often do educators rely on data from automated computer systems to assign grades or advance students? National data on these questions, if we had them, would give us a rough idea of the extent and seriousness of the danger, but for now we can only guess.

Our guess is that some schools—those that have adopted one of the commercial integrated learning systems and those where the use of computers has been imposed by district officials—may be running this risk now. In our judgment, dehumanization by over-standardization through the use of computers is more likely to become a widespread risk in schools in the U.S. if traditions of local control of schools and

academic freedom for teachers are undermined, circumvented, or overthrown. Computers may encourage those who would challenge these traditions. They certainly provide them with new and powerful tools.

12. Will computers dehumanize education?

12.1. Summary of results of grounded analysis

Now that the various versions of the concern over dehumanization have been considered, along with challenges to them, it is reasonable to return to the original question. Will computers dehumanize education? But it is now clear that this is not the kind of question that admits of an unequivocal answer provable beyond a reasonable doubt. Even if we have managed to identify all the risks, and correctly to have assessed their seriousness and likelihood to everyone's satisfaction, people of good will may still disagree about the seriousness of the overall threat because they place different priorities on various values at stake or have different tolerances for risk. The best we can do is to offer our own overall judgments and invite readers to give them due consideration.

We conclude from this analysis that there are valid grounds for concern about dehumanization arising from the use of computers, but the most serious risks are not exactly the ones people worry about most. We need not worry that most students will turn away from human relationships to work on computers, at least not for the foreseeable future. But there is a risk that some students who spend a great deal of school time and all their free time working on computers may already be harmed by withdrawing too much from social interaction, and more students who happen to be vulnerable to this syndrome can be expected to withdraw if the use of computers in schools expands markedly while nothing is done to guard against this danger.

Likewise, for most students and teachers, the student-teacher relationship does not appear to be in any imminent danger from computers. Computers may strain students' relationships with teachers whose computer competence is low, especially if they teach math, science, or other subjects where computers are believed to play a central role. When students know more about computers and use them more fluently than the teacher, the traditional image of the teacher as the expert in the subject is more difficult to sustain.

The student-teacher relationship would be even more widely and seriously threatened were computers used to replace teachers or to reduce their role and status. Pressure to reduce the cost of education could conceivably power such a movement to replace teachers with computers as an economy measure. (We should note however, that although economic arguments are regularly offered for replacing human labor with computer power, experience has shown us that in many instances computerization—when one factors in the costs of maintenance, keeping up-to-date, and technical expertise—turns out to be a far greater economic burden.) Even if this were done in a way that preserves or even enhances the role and status of the remaining teachers, it would still increase the risk of this version of dehumanization.

Computers as used in schools today pose little threat to the teaching of values because they are so seldom used. Concerns on this score are nevertheless well founded in schools where computers are for technical study that displaces the study of more humane content. Most high schools have recently added technical computer courses, often in new departments separate from math and science. In some schools enrollment in these courses consists disproportionately of children from poor and minority households. If these children have less opportunity to study more humane content, the threat to the teaching of values would be real for them. These situations bear watching by those who feel this concern.

The risk of over-standardization from simply using computers is small, but it becomes large when control over computer systems is vested in more distant and less accountable authorities. Furthermore, new dangers appear which may be even worse, such as loss of responsiveness and accountability in the educational system.

In our opinion, none of these risks is widespread now, and none of them poses as grave or tangible a threat to students as, say, violence or drugs. But the risks are real, some students and teachers are surely suffering from them now, and they could easily become widespread and serious if nothing is done.

How certain are we of this conclusion? Only as certain as the scope of what we know about the general effects of computerization on schools. Our minds could be changed by better evidence of several kinds. Suppose careful studies were to show, for instance, that children who use computers excessively actually manage by doing so to avoid emotional damage from negative experiences with other children, such as teasing, bullying, ridicule, or rejection. If these students then go on to use computers to form constructive, albeit attenuated, online relationships, and grow up to live satisfactory social lives as adults, we would conclude that the dangers of social withdrawal are minimal. By contrast, if evidence came to light showing that schools were replacing the study of literature and history with narrowly technical content and goals, we would regard the risk of dehumanization as serious and needing immediate attention. In short, although our opinions about the severity of these risks rest on the best evidence we could find about what actually happens when students and teachers use computers, the evidence is thin and weak.

13. Devising a practical response

What should educators do to reduce the risks of dehumanization? They cannot, practically speaking, bar computers completely from schools, but this would seem to be an over-reaction anyway. The threats from dehumanization are not yet widespread or grave, and the case for worrying, while persuasive, is not airtight. Educators could reduce the rate at which schools acquire and use computers. While this seems at first to be a prudent and feasible course of action, it is indiscriminate in that it would affect all uses of computers equally, the benign as well as the dangerous. It probably would protect against risk, but it would also reduce any benefits that might be obtained from using computers. A more discriminating policy would be to protect ourselves against the most serious risks and move rapidly to secure the other benefits that entail little or no risk.

If educators can identify the risks in detail and evaluate them individually, through an analysis like this one, they can put in place necessary protections. To protect against dehumanization, for instance, they may encourage social uses of computers over solitary ones. They may favor uses that are closely integrated with other school and classroom activities over uses that are separate from and independent of what else goes on in school. They may encourage the use of computers to teach humanistic content as well as to teach practical, technical, and scientific subjects. They may ensure that the use of computers is controlled by duly constituted local public and professional authorities rather than by technicians, bureaucrats, or corporate executives. They may insist that decisions about computers be as open and accessible as other educational decisions.

Educators can also protect against risks by a systematic program of watchful waiting, concentrating attention on those indicators associated with greater risks. In the case of dehumanization, they may monitor the time students spend using computers. Few critics worry about dehumanization when computers are used in small doses, but when computers fill most of a student's day or week in school, concerns about social isolation, the student-teacher relationship, the teaching of values, and standardization rise to a serious level. Similarly, educators may monitor those individual students who seem to be withdrawing from social life into an on-screen life. By watching closely educators may be able to find out whether this behavior is a pathological flight from reality or a constructive search for a temporary refuge from a stressful social situation. Educators may pay special attention to schools where computers are used to replace teachers in performing important educative functions and watch to see if the student-teacher relationship suffers.

Finally, educators can tailor their actions to their local situation. The risks that are most serious in a specific local school should determine what uses of computers are encouraged there, not the risks thought to be highest on the average in the state or nation. For instance, much less protection against over-standardization would be needed in a locality where schools have a tradition of active parental involvement and strong community leadership in school affairs than in one where a powerful, unresponsive board or central administration run the schools.

Actions would and should depend, also, on educators' degree of concern. Those only mildly concerned about students withdrawing from social interaction might monitor informally the time the most computer-active students spend working individually at a computer. Those who are more concerned might want school leaders subject all proposals for computer use in the school to a formal review focused on whether the activities would increase or decrease the risk of social withdrawal. Those with a serious, pressing concern about this issue might move to limit the number of hours students may work alone at computers in school or require that all school-sponsored uses of computers be done in groups.

So, while the use of computers may entail some threat of dehumanization, it appears that educators have practical responses that can protect against what we have found to be the most serious threats. They are not helpless against the onslaught of technology. They can use powers already available to them within existing institutions to protect themselves, our children, and us from possible dehumanization due

to the use of computers in schools. They can take effective action even if they are not yet prepared to lie down in front of the computer delivery trucks. Educators can craft a protective response as forceful as their convictions require and tailor it to their situation in as subtle and nuanced a way as they know how.

13.1. A need for technical competence among educators

The last phrase in the previous sentence, however, raises an important question about our ability to protect ourselves against these risks. Educators will only be able to recognize genuine threats and take appropriate protective measures if they know the technology well, as well as they know the subject matter they teach and the principles and techniques of teaching. Otherwise they risk acting on mistaken ideas about the technology. Yet few teachers claim to be well prepared when it comes to computers. The Office of Technology Assessment report, *Teachers and Technology: Making the Connection*, reviewed the evidence and stated as one of its key findings that “A majority of teachers report feeling inadequately trained to use technology resources, particularly computer based resources [22].” Teachers who are unprepared to use computers are even less prepared to evaluate the risks of using them and to take measured action to protect against these risks.

Educators who feel inadequately trained could, of course, delegate decisions about the use of computers to their computer-expert colleagues, but this carries risks of its own. Clearly, access to advice from trustworthy computer experts is crucial. The technology is so enormously complex and rapidly changing that only highly trained and able people who devote their entire careers to it can keep up. But it seems unlikely that those who are concerned about the risks of using computers in education would completely trust the objectivity of computer experts or even of close colleagues in education who have demonstrated their faith in the promise of computers by investing the time and effort to become computer experts. In educational governance, too, there is no substitute for an informed electorate.

This will not be welcome news to those who worry about the effect of computers on education. To be told you must learn a great deal about something you suspect may be harmful can hardly be welcome news. Even those educators who want to learn more about computers often balk at the investment required. As one of the educators we spoke to told us, “Computers are greedy. They demand so much money and time—two things that are in short supply in schools.” The demands are made worse by obsolescence so rapid what much of what is learned must be relearned every few years.

This is not just a minor practical glitch; it is a genuine bind with no easy way out. If most educators remain uninvolved and uninformed about computer technology, computers will not disappear from schools. Instead, a technological elite will develop educational applications of computers, and we as a society will lose the protections against various risks such as dehumanization that educators can provide. Yet for enough educators to develop enough technical competence to enable local educators everywhere to exercise informed control over the use of computers, would require an enormous and continuing effort to teach educators about computers. Even

assuming that such an effort is feasible—that most educators could and would learn the technical material, that the resources could be found to teach them, and that the political will could be generated to direct the resources to this purpose and not just once but on a continuing basis—such a massive investment of resources cannot be rationally justified. If somehow we knew with reasonable certainty that computers would markedly improve education, then we might be able to justify the investment. Otherwise, it is a gamble. In other words, in order to prepare most educators to make sound judgments about the use of computers in schools we must gamble that computers are, on balance, educationally valuable, a judgment that requires the very preparation we seek to provide.

We can ease this bind in many ways, but we cannot escape it entirely. For instance, we can design and implement effective programs of technical assistance to teachers. We can support informal social processes that foster self-help and collaboration among colleagues. We can redesign the technology so that it takes less learning and relearning. We can develop more efficient and effective ways to teach educators about technology. But anything we do to better prepare educators requires resources, and so a gamble must still be made. The fewer educators who are informed and involved in the use of technology, the greater the risk of such negative effects as dehumanization when computers are used in schools. Not to gamble on the preparation of educators amounts to a bet that the use of computers for education can safely be left in the hands of a technical elite.

The bottom line: educators can protect us against such risks as dehumanization but only if most of them are technically qualified to assess technology's risks and judge the merits of protective measures.

13.2. Responding to critics of a grounded analysis

Critics may argue that a grounded analysis is biased in favor of technology. Any analysis that accepts conventional ideas about technology and education will be biased in favor of technology if those ideas favor technology. Such an analysis will inevitably underestimate the threats from using technology for education. It is by no means clear, however, that an analysis based on established, accepted views of education and technology is necessarily biased in favor of technology. Although many critics charge that contemporary society accepts technology uncritically, worships technology, or even that it is essentially technological, technocentric, or technocratic, this charge is hotly disputed by other critics who maintain that contemporary culture, although it accepts technological innovations, is hostile to technology, refusing to make the effort to understand scientific and technological principles, withholding support for research and development, blaming technology for every misfortune, and rejecting technological perspectives for more traditional ones. Whichever side of this debate one takes, it would be difficult to make the case that educators as a group are biased in favor of technology, and it is their perspectives that we primarily take in this analysis.

Furthermore, even if we accept for the purposes of argument that the prevailing perspectives are biased in favor of technology, this bias would not necessarily prevent

us from identifying at least some dangers computers may pose for schools. Some dangers may be so evident that even supporters are forced to admit to them. If any initial bias in an analyst's perspective were to blind that analysis in principle to all contrary conclusions, then we could simply note the bias of the analyst's perspective and ignore the analysis.

In our case, the analysis did enable us to conclude that some dangers were worthy of educators' concern. Moreover, the conviction that an initial bias dooms any analysis cuts both ways. If an analysis based on established, accepted perspectives is biased in favor of technology and if this bias blinds all analysts who adopt this perspective to serious dangers, then by the same reasoning analyses based on counter-cultural perspectives should be biased against technology and all analysts who adopt them would necessarily find dangers where none really exist.

Finally, and most tellingly, the purpose of our analysis is precisely to identify and describe dangers that would and should concern those who adopt conventional perspectives. We grant that other perspectives may reveal other dangers, but those dangers will not appear as dangers to those who hold conventional views.

Critics may also offer a second objection to a grounded approach, namely that it is trivial, that it contributes nothing to our understanding of these issues, fails to take us beyond the present level of understanding. An approach that accepts established, accepted perspectives is not cutting edge thinking, it may seem, and cannot advance the discussion. Without a critical examination of the accepted perspectives in light of other contending perspectives, how can the analysis move beyond the surface level? In this case, critics might argue that serious treatment of concerns about computers contributing to dehumanization surely requires a consideration of such conceptual themes as the metaphorical nature of language and thought, subjective experience and the character of inner life, the commodification of knowledge and relationships, and the role of symbols and narrative in the passing on of values, among other novel, original viewpoints.

The essence of this criticism is that our understanding of social and ethical issues depends primarily on the ideas we use to frame our discussions of them, and that the effort to ground the discussion in experience has distinctly less value. According to these values an entirely conceptual argument that involves an unconventional idea—for instance Jacques Ellul's thesis about the autonomous logic of technology being the dominant force shaping Western societies—would be an important contribution, whereas an analysis of the operation and influence of computers on classroom interactions would lack conceptual depth and add little of substance to the discussion. We reject this interpretation and this valuation. Purely conceptual arguments subjected only to the challenge of other conceptual arguments in exclusively theoretical debates have their place, but they are not the only worthwhile way to enrich discussion of social and ethical issues. Philosophers, social critics, and other academics may properly set a higher value on conceptual argument within their disciplines, and it may be that a grounded approach contributes nothing to their discussions. Nevertheless, a grounded analysis such as this does in principle have much to contribute to the understanding and appreciation of the dangers of computing on the part of educational scholars and practicing educators. We hope and believe that our

analysis has shown that grounded approaches can be valuable, too, especially in the here and now and especially to those responsible for decisions about the use of technology in schools.

14. Conclusion

In closing we would like to share some convictions we have come to hold as a result of carrying out this analysis. When we began the conversations that led us to write this essay, one of us was typically more inclined than the other to be concerned about dehumanization. Our first conversations were polite debates in which one of us would consistently and sincerely defend a particular criticism while the other would challenge it. As we argued and read and talked with others, our positions became more complex and less monolithic. Often some line of argument or piece of evidence changed our minds. Sometimes one or both of us gradually lost conviction as we examined other views on the subject. Sometimes our roles shifted, and the one who was most worried began to doubt and eventually to challenge the concerns now defended by the former challenger.

We took these changes of mind to be encouraging signs. They showed that the arguments and evidence we were uncovering carried substantial weight with us and that our minds were open. Eventually our vacillating opinions settled down. In some cases our two views eventually converged. In other cases we continued to differ, but we were better able to identify the sources of our disagreement in different beliefs, values, priorities, or willingness to incur various types of risks. Ultimately, the experience of carrying out this analysis changed our opinions and beliefs in important ways and led us to new convictions not only on the primary question, but also on important related questions.

One conviction that has formed in us while doing this work is that much is to be gained if educators will face their fears about computers and discuss them openly. We spoke with many educators who worried that they might be laughed at or dismissed as ignorant, old fashioned, or obstructionist if they expressed concerns about using computers. We urge them to speak out. As we have seen here, those fears may lead to the identification of real risks that educators should take seriously. A second conviction is that educators should play the leading role in determining how and whether computers are used for education. We will feel much less concerned and much more secure against possible harm if technically qualified educators are in control than if technicians, officials, and corporate executives call the shots. Educators face a difficult choice, individually and collectively, between engaging with computer technology and excluding it from their professional lives. Engaging the technology requires a substantial investment of time, effort, and resources to build the competence to make responsible professional judgments. Excluding the technology—ignoring it is a form of exclusion—leaves educators unqualified to judge whether or how best to use the technology for education. We know that many find the technology difficult, frustrating, distasteful, and possibly dangerous, but we hope, for society's sake, that most educators will nevertheless choose engagement.

Engagement does not mean advocacy. Educators can engage as critics, if that is their considered professional judgment, but let it be as informed, responsible critics. Some want to establish havens within schools where computer technology is not allowed or even whole schools where computers are banned, a kind of educational reserve similar to a wilderness area or protected historical community, where traditional education can flourish undisturbed by electronic devices. Such havens may prove beneficial. We believe that maintaining excellence in traditional forms of education is vital. Otherwise, computers may be adopted for the tragic reason that they are no worse than what we have. Furthermore, we all gain from the preservation of educational diversity. If children emerge from these havens better educated and better able to live satisfying, productive lives, the superiority of traditional education will be apparent, and other schools will follow their lead. But responsible professionals should be sure before they opt for such a haven that they do so for sound educational reasons and not simply to evade their own unexamined fears of technology.

Another conviction we have formed from our work on this question is that we all have a pressing need to understand what actually happens when teachers and students use computers for education. Debates about the use of computers for education too often begin and end with theoretical arguments about technology in general and its impact on society. Advocates for computers in education argue that technology is a primary engine of economic and social progress and that educators must use it or be left behind. Critics, by contrast, emphasize the negative consequences of technology in human life and urge that education be spared a similar fate. Both sides tend to see the issue of computers in education as simply another round in the larger, ongoing struggle over the role that technology should play in our lives.

These sweeping analyses rest on loose and questionable analogies between different forms of technology operating in different sectors of society. Consequently, debates at this highly theoretical level are seldom productive of new insights. For example, critics employ analogies with business and the military to argue that the use of computers for education will foster a narrowly technical mindset. Champions of computers reply that computers, like books, can be used to foster any kind of mindset whatever, depending on how educators choose to use them. Arguments and counter-arguments then flow back and forth predictably between the pro-technology and anti-technology camps. Meanwhile we know next to nothing about what kinds of mindsets are actually fostered by present uses of computers in schools. We need to hear the arguments of those who put their faith in technology as well as their critics, but we also need more empirical evidence that pertains particularly to what actually happens when people try to use computers for education.

Finally, we are convinced that continuing, constructive dialogue is needed on key issues of policy and practice in the use of computers for education. To consider and resolve legitimate questions about the use of technology for education we need a public dialogue that considers the contending positions fairly in light of the complexities of real life in schools. It would be best if this dialogue were managed by the educators actually responsible for decisions about the use of computers and if it were focused on the particular decisions they face in their particular situation. We have tried to represent the outlines of such a dialogue in this paper and to show how

it can lead to a principled and justifiable resolution of such issues. Our analysis is surely not the last word on the issue, but we trust it is at least a good start toward a fair and informed examination of the issues. Those who carry on the continuing dialogue can identify and correct the errors, rethink the analysis, and reach a fuller, fairer, more deeply considered resolution.

A substantive dialogue about these concerns is a constructive, professional response to issues that are all too often treated as occasions for ideological battle. When exchanges between critics and advocates of computers in the schools take the form of a partisan struggle for the hearts and minds of an ill-informed profession and public, the result, regardless of who wins, is not necessarily a victory for education. A substantive dialogue that can form the basis for reasoned action and response—both in the classroom and in the academy—although difficult to sustain, is a genuine victory for all.

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