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ABSTRACT

The personal computer is the latest educational technology to fall short of its original promise. Although United States public schools now possess 5.8 million computers, roughly one for every nine students, they are not widely used in classroom instruction. This paper argues that the most popular explanations for lack of computer use fix blame on recalcitrant bureaucracies and stubborn teachers. By enlisting technology in the cause of educational reform, computer advocates overlook some of the real obstacles to the use of computers in classrooms. These obstacles are rooted in organizational constraints of the school system and the essential nature of teachers' and students' work. The paper examines the world of teachers and students to uncover how their interactions limit the computer's impact on schooling and describes how these limitations are viewed by leading architects of public policy promoting educational technology, in particular a report published by the U.S. Congress's Office of Technology and Assessment in 1995. A conclusion is that computer advocates must separate their agenda from other reform agendas. The campaign to promote computer technology in the schools should stress three elements: (1) developing a strong technological infrastructure through investments in adequate school facilities; (2) using computers to make teachers' work easier and more efficient, not to redefine teaching; and (3) employing computers to increase student academic achievement, not for changing current ideas of valued knowledge. (Contains 54 references.) (LMI)

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Abstract

The personal computer is the latest educational technology to fall short of its original promise. Although U.S. public schools now possess 5.8 million computers, roughly one for every nine students, they are not widely used in classroom instruction.
Why not? In this article, I argue that the most popular explanations mistakenly fix blame on recalcitrant bureaucracies and stubborn teachers. By enlisting technology in the cause of educational reform, computer advocates overlook some of the real obstacles to the use of computers in classrooms, obstacles rooted in organizational constraints of the school system and the essential nature of teachers' and students' work.

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Why Aren't Computers Used More in Schools?

Critics of American schools have historically expressed unrestrained optimism in the power of new technologies to change the face of education (Cuban, 1986; Means, 1994). More often than not, however, this optimism has been followed by disappointment. Why do inventions that fundamentally alter the way we communicate or the way we are entertained barely dent the daily routines of classrooms? Why have computers succeeded in revamping how we buy gas, shop at grocery stores, and manage our bank accounts, but left classroom instruction virtually untouched?

The following essay tackles these questions in an examination that proceeds from the ideals of visionaries to the realities of classrooms. I first describe the ideas of two prominent computer enthusiasts, two visionaries who see technology as the linchpin of efforts to improve American education. I then describe the extent computers are used in schools and discuss some of the structural features of the school system that hinder their widespread utilization, focusing in particular on constraints that are often overlooked or downplayed by computer advocates. Having arrived at the classroom door, the essay enters the world of teachers and students to uncover how their interactions limit the computer's impact on schooling. I also describe how these limitations are viewed (and misunderstood) by leading architects of public policy promoting educational technology, focusing in particular on a report published by the U.S. Congress's Office of Technology and

Assessment in 1995, Teachers and Technology: Making the Connection (hereafter cited as OTA, 1995). In this report, the belief that computers should assume a more important role in the classroom is wedded to an indictment of classrooms' traditional practices.

I think the approach of the OTA report is a mistake, and I argue in this essay that promoting computer technology should be separated from the press for educational reform. By anchoring the virtues of technology to a condemnation of current classroom practices, advocates of more computers in classrooms only hurt their own cause. The short answer to the question posed in the article's title--why aren't computers used more in schools?--is that computers will become an important tool of classrooms when they are rooted in the commonplaces of schooling, in classroom work as it is currently constituted, not as reformers believe it should be constituted.

The Problem

From Silicon Valley to Washington DC, technology's movers and shakers are understandably frustrated with educators' hesitant first steps into the Information Age. But blame can also be levied outside the schoolhouse. Industry leaders have long ignored the most important person in the conduct of America's classrooms--the teacher--and have instead focused their research and development efforts on how individual learners

interact with technology. Because they then believe that they have discovered better ways of defining the learning experience, these leaders neglect the teacher's central role in instruction and grossly oversimplify the complexities of schools, especially the classroom settings where instruction occurs. It should come as no surprise that teachers and administrators appear obstinate and backward when techno gy is offered to them for the express purpose of radically changing the character of their work.

Fault can also be found among school reformers. Consider two camps--those who see regressive teaching practices thwarting technology's potential for learning (Merrow, 1995) and those who believe that entrenched educational bureaucracies do not allow the computer's liberating potential into their domain (Perelman, 1990). Such explanations conform to these writers' complaints about teachers and school systems and bolster their particular agendas for how education should be changed. In both cases, the status quo is found guilty of a sin that Americans consider singularly unforgivable--spurning the shimmering promise of the future--as anachronistic pedagogies and bloated bureaucracies conspire to thwart the beneficence of computers.

Both explanations are burdened by romanticism. Merrow would have us believe that ignorant teachers and their penchant for controlling instructional processes are the primary reasons for the modest use of computers in classrooms. Once we dethrone authoritarian teachers in favor of ever-inquisitive students,

Merrow argues, computer-based learning will flourish, and students who now cannot read simple sentences will somehow "design cities, compose their own music, or browse through a library in Japan or London" (Merrow, 1995, 52). Perelman's bogey man is the system of tax-supported public education, a system that, with technology's help, will dissolve into a wondrous marketplace of individual agents. Consumers will peruse a video display of instructional options piped directly into their homes and use vouchers to purchase learning tailored to their individual needs (Perelman, 1992).

Pundits like Perelman and Merrow base their arguments on pristine visions of system and pedagogy, visions that are ideological products--and noticeably distant from the messiness of real school systems, real classrooms, and real children. These writers offer only a hint about what really stops computers at the schoolhouse door. Systemic and pedagogical forces do indeed shape the use of technologies in schools, but these influences have little to do with Luddite bureaucracies or Neanderthal teachers. They arise instead from organizational constraints common to school systems and from the daily work of teachers and students. Before examining these factors, let's first look at the extent to which computers are utilized in schools.

Use of Computers in the School System

The proportion of schools reporting the use of at least one personal computer expanded dramatically in the 1980s, from about 30% of schools in 1982 to over 95% in 1988 (U.S. Department of Education, 1993). By 1995, schools possessed an estimated 5.8 million computers, roughly one for every nine students [OTA 1995].

Getting computers into schools and employing them in instruction are not the same thing, however, and computer usage lags far behind the mere presence of machines in schools. In 1990, fully 70% of eighth grade students reported never using computers in their mathematics classes (U.S. Department of Education, 1993). In terms of instructional modality, this places frequency of computer use at about the same level as giving reports and completing projects, far below the frequency of the two most popular activities--completing worksheets and solving problems from textbooks. An international study conducted in 1992 verified infrequent computer use as a worldwide phenomenon (Anderson, 1993). In Germany only 15% of eighth graders reported considerable computer use in their math classes, with the U.S. (7%) and other countries trailing behind [Austria (7%), Netherlands (7%), and Japan (2%)]. More recent studies reach the same conclusion: computers may exist in schools but they have yet to emerge as a critical tool of teaching (OTA, 1995). Why not?

Organizational Constraints

In the U.S., a primary reason for computers' lack of use can be found in the structure of computers' availability. Penetration of schools is only the first step in diffusing computer technology; penetration of classrooms is far more important when it comes to instruction. One problem is that schools frequently gather together computers into centralized labs. This arrangement provides students with equitable and efficient exposure to specially trained instructors, integrated learning systems, and a broad array of software (Newman, 1994). The downside, however, is that even well-stocked computer labs severely limit the technology's accessibility for classroom instruction. Labs deny teachers the flexibility of deciding when technology should be incorporated into instruction, unwittingly conveying to students that computers are not central to learning, and certainly not central to the activities of their classrooms.

Another factor affecting computers' availability in classrooms is an inadequate infrastructure. Schools that ambitiously acquire computers for their classrooms often run up against insufficient electrical wiring, the absence of telephone connections, and insufficient air conditioning to protect the machines (see Jonathan Kozol's (1991) sad story of one school's melting computers in *Savage Inequalities*). With less than 15% of classrooms wired for telephones--hardly cutting edge

technology--it is a pipedream to think that most schools will soon be traveling the information superhighway.

Budgetary constraints prevent a quick remedy to the situation. A recent federal report estimated that it would take $100+ billion to take care of schools' current deferred maintenance--leaky roofs mended, broken tiles and windows replaced, sagging walls fixed--so the chances of additional capital improvements to accommodate PCs are doubtful (General Accounting Office, 1995). Moreover, installation of computers is only the beginning. Schools often encumber unforeseen financial obligations by failing to factor the expense of maintenance and obsolescence of machines into long-term technological planning. Davis (1995) reports that one Virginia school district's costs for these items, expenses the district had failed to anticipate, ballooned to nearly $250,000 in five years. Although the problem had not been solved when his research was conducted, Davis wryly speculated that this shortfall would be rectified, of course, by reducing future appropriations for new technology.

The dominance of hardware in schools' technological investments has also inhibited PCs' popular usage in classrooms. Emphasizing procurement and installation of PCs, with little thought given to why they were needed or how they would actually be used, has resulted in many classrooms that are "all dressed up with nowhere to go." Durost (1994) argues that technological planning should start from the end point of instruction--deciding

what it is educators want computers to do for them and their students--and then map backwards, deciding on appropriate software and ancillary equipment (i.e., printer, CD-ROM, modem) before purchasing the necessary hardware. On a similar note concerning the Internet, Maddux urges educators to think first about how telecommunication will be used educationally before rushing into costly commitment of resources (Maddux, 1994).

The Public and Private Sectors

To conclude this section, let's return to Perelman's contention that the public school system stifles budding technologies. As we have seen, the public system certainly does exhibit structural deficiencies that hinder technological innovation. But the problem is not unique to the public sector. Are private schools more likely than public schools to offer students access to computers? No. In fact, despite the daunting obstacles public schools face in obtaining computers, the number of students per computer is less in public elementary schools than in private schools (17.5 to 1 versus 20.5 to 1; Anderson, 1993). Private school educators lag their public school counterparts in bringing computers onto campuses.

Perelman admits this deficiency but blames both sectors for their reliance on old-fashioned "brick and mortar" delivery systems, for the immobile buildings and classrooms making up the dominant image of the school, as a solid structure anchored to a

particular place. He calls for consumer "microchoice" in education, for vouchers that would allow prospective learners to purchase the knowledge they want from a menu of different instructional modalities. Why isn't the current system rushing towards this utopia? Perelman draws on anti-governmental rhetoric to claim:

> U.S. public schools and colleges are technologically stuck in the Middle Ages for the same reason Soviet collective farms were: a complete lack of accountability to the consumer and total insulation from market forces. Central, bureaucratic, "command" management provides no incentive--and a thicket of discouragements--for productivity, and hence for innovation (Perelman, 1992, p. 185)

Perelman later uses the spotty history of technological innovation in the school to return to the metaphor of the Soviet collective farm:

> Continual attempts to inject technological innovation into American schools and colleges through subsidized experimental, pilot, and demonstration projects or top-down bureaucratic mandates have failed as thoroughly as similar initiatives in the Soviet state agricultural system...In contrast, American agriculture has become the most productive in the world because adoption of technological innovation has been motivated by the competitive forces experienced by independent, market-driven enterprises.
>
> In essence, the public school is America's collective farm. Innovation and productivity are lacking in American education for basically the same reasons they were scarce in Soviet agriculture: absence of competitive, market forces (Perelman, 1992, p. 225)

This argument suffers from several problems. First, as I've already noted, competitive market forces have not spurred private schools to readily embrace PCs. The metaphor is also a poor fit. Instead of resembling a Soviet collective, the U.S. school system is one of the most decentralized operations in the world, embodied in over 14,000 independent school systems, each with an autonomous bureaucracy and governing board. This far flung enterprise is significantly less centralized than many of America's most important private sector enterprises (e.g., automobiles, oil, broadcasting). As for American agriculture, not only does it enjoy the protection of tariffs and the largesse of government subsidies, agricultural research is well-funded by governmental grants. Financial columnist David Warsh points out that government funding of research in general has stimulated rather than blocked technological innovation. Speaking of federally supported research, Warsh argues:

> "It's not the only source of new technology, but it may have been the most powerful for the last 60 years. The computer, the semiconductor, microprocessors, satellite telecommunications, lasers, jet airplanes, materials science, manufacturing robotics, antibiotics, genetic engineering, the revolution in linguistics, artificial intelligence--all arose from federal interest in developments in their earliest stages, usually in the name of national defense" (Warsh, 1995).

The glaring irony of Perelman's analysis is that education's savior, the computer, largely owes its existence to Perelman's villain, the government. Additional evidence indicates that

one's choice of instructional modality is unrelated to the sector in which it is exercised. To prepare for SAT tests, consumers may pick from several attractive books, computer programs, and video tapes offered in the marketplace. Despite the increasing competition from technology, however, companies offering teacher-led preparation for the SAT continue to boom, even though they are far more expensive than their non-teacher rivals.

The marketplace appears no more effective than public schools at organizing educational interactions around computer technology. Something is at work here that transcends obdurate bureaucracies or the self-serving omnipotence of the educational establishment. People apparently don't mind getting money, gas, or groceries with the help of machines but prefer to get their learning from teachers. We apparently don't trust ourselves to learn on our own all of the things that we need to learn, and we may instinctively know that machines will give us more control over our own learning than we really should have. By choosing teachers over other instructional systems, students of all ages shun individualization for instruction in groups and, in the case of adults, willingly cede primary control over their learning to someone else's authority, the authority of the teacher.

The Work of Teachers and Students

All of the problems discussed thus far--the limitations of housing computers in central labs, the incompatible structural

conditions of schools, the strained budgets, lack of planning, and dominance of hardware purchases in education--are clearly important problems to solve. They probably can only be overcome by allocating additional resources for such things as rewiring school buildings, purchasing up-to-date equipment, and contracting with outside experts--for constructing a strong technological infrastructure within the educational system. Of course, it is nothing new for schools to need more money. Unfortunately, however, even with abundant resources the odds remain decisively stacked against computers soon becoming mainstays of classroom instruction. Financial need is <u>not</u> the most frequently cited obstacle to the full use of computers in schools. The most frequently cited obstacle is the classroom teacher.

According to several studies, teachers are woefully unprepared for using computers in their teaching except in the most basic forms of instruction, those involving drill and practice (OTA, 1988; OTA, 1995). This research indicates that teachers have received neither adequate computer training in professional preparation programs nor the necessary support while on the job to effectively employ instructional technologies (Zammit, 1992).

Despite the overwhelming evidence supporting this conclusion, there is something troubling about the ease with which these reports have cast teachers' ignorance as an

intractable barrier to new technologies, the ease with which they have fingered teachers as the primary force blocking students' exposure to computers. Granted, teachers should know more about new technology. But they do know quite a bit about teaching, certainly more than many of the experts who write about the computer problem--more than most university-based school reformers, for example, who fail in their own instruction to use computers either extensively or creatively (Morton, 1996), and more than most non-teaching pedagogical pioneers, who judge current practices against their own reform agendas, not against the day-to-day imperatives of classrooms.

Teachers can be at the heart of this problem, however, without ignorance serving as the principle barrier to computers' acceptance. The real culprit may be the nature of teachers' work. Diffusion of new technology along the frontline of any organization depends upon the innovation's compatibility with the core tasks of operators on the shopfloor (Wilson, 1989). Managers and executive level personnel will also resist innovation if they believe new technologies violate institutionalized definitions of work roles and bureaucratic authority. In her study of the Ninth Infantry Division's adoption of a new decision support system, Fountain (1995) found commanders extremely reticent about innovative information technologies, mainly because "the use of information technology for command and control implicitly calls into question the value

and the proper role of their experience, intuition, and judgment" (Fountain, 1995, p. 36) As applied here, limitations on the widespread utilization of computers in education may originate from the core operations of schools, and especially from the classroom roles embodying the day-to-day tasks of teaching and learning.

Nothing startling here either. Teaching and learning--as practiced today--may impede the computer's adoption into classrooms. Computer advocates are savvy to this possibility, but they tend to point to it as one more reason for totally overhauling contemporary teaching practices. This conclusion reinforces three unfortunate aspects of the advocates' cause: their faith that policies promoting technology can shape instruction; their desire to alter tasks rather than to improve the performance of classroom workers at current tasks ("workers" referring to both teachers and students); and their failure to recognize challenges arising from what Dan Lortie calls teaching's "endemic uncertainties" (Lortie, 1975). Let's examine how these three flaws seriously impede the campaign to integrate computer technology into classroom routines.

Changing Instruction Through Policy

The Office of Technology Assessment's 1995 report *Teachers and Technology: Making the Connection* is a good example of policy studies promoting the use of computers in schools. The report

focuses on changing teachers' attitudes, knowledge, and behaviors so that technology receives a warmer reception in schools. The report stresses:

> At the center of effective use of instructional technology is the teacher. For students to become comfortable and effective users of various technologies, teachers must be able to make wise, informed decisions about technology" (OTA, 1995, p. 50).

By spotlighting several teachers' exemplary use of technology in their classrooms, the second chapter of the report describes "how technology can support, enhance, and in some cases redefine the job of teachers" (OTA, 1995, p. 51). We are warned, however, that "the accomplished teachers whose experience is described in this chapter probably make up only a small percentage of all U.S. teachers" (OTA, 1995, p.54). Chapter Three and Chapter Four describe some of the organizational and infrastructural problems described earlier in this paper, and the fifth and sixth chapters follow up by proposing a new teacher preparation and professional development program, the centerpiece of a vast new federal push for educational reform.

Woven throughout the report is a persistent theme: technology will not achieve a prominent place in American education until teachers' instructional practices are changed--until teachers' propensity for traditional instruction is trained out of them.

The report's appetite for change, however, outstrips educational policy's capacity to effect it. Exercising governmental authority, or in a word 'policy', to promote educational innovation has a checkered past. When implementation research came into its own in the 1970s, policy makers were stunned to discover that local school environments powerfully influence the manner in which governmental policies play out in schools (Berman and McLaughlin, 1973-1978; McLaughlin, 1991). Forces in the local environment are able to overwhelm upper-level strategies for gaining the compliance of practitioners, and more often than not, policies' original objectives are reinterpreted to fit local conditions (Darling-Hammond, 1990; Elmore, 1980; Huberman and Miles, 1984; Spillane, 1994).

No setting has appeared more impervious to external reform than the classroom, especially when it comes to changing methods of instruction (Cohen and Spillane, 1992). Initiatives designed to alter ways of conducting instruction have met with continual disappointment. Large scale federal efforts to create new math and science programs in the 1960s succeeded in capturing the attention of academics, the policy community, and the media, but just a few years after an initial burst of enthusiasm researchers found most of the new instructional materials hidden away in storage closets, not in classroom use (Welch, 1979; Ravitch, 1983).

In the 1980s, reformers again pushed to change the dominant instructional regimes of mathematics and science teachers. State after state adopted policies urging math and science teachers to reform several aspects of their teaching. The National Science Foundation, the Department of Education, and dozens of individual states invested in extensive professional development. Despite these efforts, data from the National Assessment of Educational Progress (NAEP) show that math and science teachers only infrequently employ manipulatives in their instruction, rarely organize students into small groups for class work, and almost never assign projects and papers to students while teaching math and science, three practices warmly endorsed by reform initiatives (U. S. Department of Education, 1993).

A group of Michigan State University researchers (including David K. Cohen and Deborah Ball) studied teachers' reactions to California's 1985 mathematics framework, one of the most ambitious reform documents of the period. Their findings demonstrate the daunting challenges facing reforms originating outside the classroom. When reformers attempt to fundamentally change instruction, they simultaneously identify the teacher as both problem and solution, as the factor that must be changed and as the agent of that change. How teachers reacted to the state's instructional reforms vividly illustrates the paradox. Some teachers just flat out rejected the new framework and went on teaching as they always had. More disheartening to supporters of

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new pedagogical approaches, even teachers who embraced the reforms interpreted the meaning of change through the prism of their own teaching practices. They defined novel teaching objectives in familiar terms, and rather than drastically overhauling their instructional approaches, reshaped innovative practices to fit with customary teaching strategies (Cohen and Ball, 1990; Cohen, 1995).

In 1995, after California experienced steadily declining scores on national tests of mathematical achievement, the 1985 framework and its 1992 successor came under furious attack for promoting unproven instructional practices. The state's new school superintendent appointed a special commission, including several defenders of the frameworks, to investigate the causes of the decline. In a remarkable admission for policy makers, the commission's report argued that the state-supported instructional reforms remained tenable because of the unknown degree to which they were implemented in classrooms. Since we don't know if teachers are actually following what we have recommended for the last decade, the commission reasoned, we certainly can't blame the state's instructional reforms for students' falling math scores (California State Department of Education, 1995).

The commission's report and the OTA document share the same fatal flaw: the exuberant ambition to prescribe instruction. If teaching is a profession, then instruction is the center of gravity around which a teacher's professional identity revolves.

Instruction flows from the confluence of personal and professional histories. Fundamental shifts in teaching practices occur incrementally--even if helped along by state and federal policies, professional development plans, collegial networks, and inservice full of fire and brimstone. Change in instructional practices cannot help but transpire slowly when how one teaches largely defines the kind of teacher that one in fact is.

Changing Work Roles in the Classroom

The above stories of struggling reforms also illuminate how the OTA report gets caught up in controversies concerning the classroom work of teachers and students. Clarifying the roles of teacher and student in carrying out classroom work has precipitated an ideological war that has raged among educators for most of the twentieth century--the battle between so-called "progressive" and "traditional" pedagogies. Many advocates of computers in the classroom tend to lean toward one side in this conflict, the side of progressive education. These advocates believe computers support progressivism's longstanding effort to celebrate children's innate interests, to provide classrooms that stress self-initiated, project-based learning, for instance, rather than the mastery of disciplinary-based content delivered by teachers. Many computer enthusiasts also see technology as a tool for realizing the liberating potential of the progressive

agenda, for allowing students greater freedom to control their own learning in democratic, student-centered environments (Frick, 1991).

Along this line of thinking, the progressive aspirations of the OTA report are made evident in the following passage:

> Currently the most common uses of technologies in schools reflect educational philosophies of instruction that view students as recipients of information as dispensed by the teacher (or by the technology) and the acquisition of specific skills and knowledge. However, many technology experts feel that the real potential of technology lies in its capacity to support pedagogical approaches that encourage students to become active participants in their own learning and to acquire critical thinking skills and more complex understandings...Right now a gulf exists between the ambitions of technology experts and software developers and the practice of teachers in classrooms. Helping teachers use technology to facilitate different educational philosophies will require substantial change in curriculum, instructional methods, and teacher understanding" (OTA, 1995, p. 126).

Is technology's main selling point that computers will help "to facilitate" the "different educational philosophies" favored by "technology experts and software designers"? If the past is any guide, educators will hardly flock to this message. Progressivism's failure to gain mainstream status is starkly etched in educational history (Cremin, 1961, Ravitch, 1983). In their various incarnations, progressive reformers have tried to fundamentally redefine the role of the teacher by emphasizing "child-centered" practices and active learning. Technology

experts and software designers now join this parade, and by enlisting computers in the progressive cause, embrace an educational philosophy that the vast majority of teachers have consistently rejected. Unfazed by this history, Apple Computer expresses the hope that:

> As teachers become comfortable with a shift in classroom roles, they may start extending their idea of what it means to be a teacher. If they're supported, they may also change their approach to teaching and learning--from curriculum-centered to learner-centered, from individual tasks to collaborative work, and from passive learning to active learning (Apple Computer, Inc., 1995, unpaginated).

The point here is not to alert the reader that progressivism has risen from the dead and is roaming the land in the form of technology advocacy. The point is that progressive ideas for dramatically changing the nature of teaching consistently fail because they don't win a loyal constituency where they need to--in classrooms. Although progressivism wins followers among the elites of education--the faculties of schools of education, educational administrators and bureaucrats, leaders of private schools, journalists and writers on the education scene--it has never mobilized a strong following among practitioners (Cremin, 1961).

Again, the lesson is clear: when launched from outside the system, movements to redefine how teachers teach are severely hobbled. A perceptive student of educational change, Larry Cuban, puts it this way:

> Consider the most common goal of school reform over the last century: changing teaching behavior. Already mentioned is the staggering inventory of efforts aimed at altering what teachers do in their classrooms. Reformers, however, seldom asked the basic questions: How do teachers teach? What is constant and what has changed in their teaching? Why do they teach the way they do? Instead, reformers desperately seeking improvement--as they define it--jump to the question: How ***should*** teachers teach? (original author's emphasis; Cuban, 1988, p. 101)

Changing What Students Learn

In addition to stipulating how teacher's should teach, computer advocates frequently attempt to define what students should learn, urging schools to leave behind "the acquisition of specific skills and knowledge," a position taken in the OTA quotation above. This line of argument is also counterproductive to the cause of computers in the classroom. It tells educational practitioners, parents, and local policy makers that software developers and other technology experts--not they who work with children every day--are in the best position to determine what students should learn. And it flies in the face of numerous polls that show the public wants schools <u>first</u> to provide students with a solid foundation in basic skills (Johnson and Immerwahr, 1994).

Proposing new definitions of valued knowledge dodges the unresolved issue of whether computers actually enhance student learning of traditional academic subjects. The software industry

recently commissioned an excellent summary of the research showing technology's positive effect on student achievement (Sivin-Kachala and Bialo, 1995). The 1990 NAEP test results, on the other hand, showed that eighth graders who reported never using computers in math instruction scored higher (263) in average math proficiency than students who reported using computers either weekly (249) or daily (246) in their math classes (Table 42, U.S. Department of Education, 1993). The usefulness of these scores is limited, however. If computers are used mainly for remediation, then the scores might be registering the different types of students using computers, not the effect of computers on achievement[1].

These ambiguities further cloud the campaign for new technologies. Computer advocates will strengthen their position when they abandon attempts to change the nature of student work and instead demonstrate with convincing evidence that computers can improve student achievement in traditional subject matter. Moreover, teachers are more likely to change their instructional practices if they're persuaded that change will produce good results for their students (Johnson, 1990).

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[1] Ironically, the research documenting a favorable impact of computers on achievement presents problems for instructional reformers. Although generally documenting a +.3 effect size, the studies are dominated by experimental conditions where computers provide drill and practice and other forms of didactic instruction rather than the student-centered approaches reformers favor. For meta-analyses, see Kulik and Kulik (1991) and Ryan (1991).

The Resilience of Teaching's Endemic Uncertainties

Student achievement raises an important characteristic of the public's perceptions of teaching. Think about the outputs of the educational system that command public attention; they are the products of students--amounts of learning (as demonstrated by test scores), years of education completed, diplomas and credentials earned. Teacher outputs are largely unobserved and unreported. In fact, teachers' work takes on little public importance except for its impact on the aforementioned student products. The public's stake in whether teachers teach one way or the other rarely extends beyond a particular practice's impact on student outcomes. It follows logically that most reforms designed to change teachers' work actually have indirect aims. They ultimately seek to enhance the outputs of students, and disciples are rallied around the claim that they can.

Lortie (1975) identified three characteristics of teacher's work that makes it unique, conditions he called the profession's "endemic uncertainties": (1) the classroom's essential lack of voluntarism, (2) the incomplete socialization, or immaturity, of the workers from whom teachers must elicit products, and (3) the grouped context of instruction. Even though Lortie's original findings were published before the PC revolution, a quick inspection will show that they remain inherent to the work of teachers and ever salient as potential obstacles to the use of computers in schools.

Casting educational interactions in economic terms (in terms of markets, consumers and producers, costs and benefits) masks the essentially involuntary nature of the teacher-student relationship. School attendance is compulsory until age sixteen in a majority of states, and most students select neither their schools nor their teachers. Except in rare instances, teachers also enter the educative enterprise with limited choice; they are not allowed to choose their clients nor the schools in which they work. So both teacher and student enter into their work relationship involuntarily, or at least not voluntarily in the same sense as buyers and sellers willingly engaged in mutually beneficial transactions.

This nonvoluntary milieu affects classroom computer use. The student seated in front of a computer at school is not always like the eager young explorer you see fooling around with computers at your local electronics store. Some students only like computers for playing games, others don't like computers at all. The machine's most powerful learning tools--databases, spreadsheets, the Internet--are also the least seductive to students, the least likely to utilize the dramatic graphics and sound effects adorning best-selling computer games. Compare the strategies that computer retailers use to attract potential buyers to Merrow's vision of kids exploring libraries and museums on the Internet. Merrow assumes a love of learning that any teacher would treasure. But the people whose livelihood depends

on gauging youngsters' computer preferences don't see the market quite the same way. If you go to the nearest electronics store and stroll through the computer section, what do you see on flickering monitors? Violent games, not museum tours, are the biggest draw.

Lortie's second endemic uncertainty involves thinking of children as immature workers. Immaturity is a dominant characteristic of childhood, marking this distinct period in the life cycle that only a few centuries ago was regarded as largely undifferentiated from adulthood (Aries, 1962). Children's immaturity, of course, explains a great part of their charm, and teachers frequently list the opportunity to work with children as their primary reason for entering the profession (Johnson, 1990).

Notwithstanding their delightful qualities, children are expected to accomplish work during the school day, and managing the labor of thirty or more children presents the classroom teacher with several challenges quite different from supervisors of adult workers. First, teachers cannot leave children alone for even a short while, a constraint stipulated by state education codes, school district policies, and collective bargaining agreements. While technology can bring the great libraries of the world into classrooms, the corner magazine stand and videostore can also come along for the ride. Press reports of pornography and the seduction of children on the Internet raise fear in both teachers and parents.

Second, since the ultimate payoffs of education are deferred for a length of time that is quite difficult for the young mind to grasp, teachers assume a great deal of responsibility for motivating children to work on educative tasks, for engendering a "love of learning" in students. The issue of personal responsibility for doing one's work becomes further complicated when the work doesn't get done, sometimes necessitating that the teacher bring a third party, the parent, into the picture. This complex tripartite relationship serves as an important topic in the emerging body of literature on the micropolitics of the school (Blase, 1988; Loveless, 1995).

As workers, children are immature both socially and intellectually. They must not only learn how to work with others, but competence in the technical aspects of their labors also can't be assumed (watch a first grade class work on creative writing and you are bound to see some instruction on how to hold a pencil). Children's immaturity necessitates that adults shoulder, albeit in amounts diminishing over time, responsibility for life-shaping events, educational decisions among them. As a consequence, a culture of control arises in many classrooms, with the teacher's supervisorial role expressed in a variety of authoritarian behaviors--monitoring, directing, praising, and scolding students (Waller, [1932] 1961; Dreeben, 1968; Jackson

1986)[2]. No separate time is partitioned off between math and P.E. to impart the authority transmitted through these actions. Indeed, to an outside observer it may seem as if teacher approval or disapproval greets everything taking place in the classroom, whether the teacher conveys these signals through a raised eyebrow, a shift in tone or cadence, a warm smile, or an icy stare.

The computer is an interloper on these interactions between adult and child, perhaps explaining why many teachers intuitively disdain ceding the prerogatives of instruction to the classroom computer. Analysts might confound this reluctance with the philosophical tensions between child-centered and teacher-centered learning, but it actually stems from the challenge of guiding immature workers. Teachers of every conceivable educational philosophy transmit norms and expectations to their students, and these transmissions are embedded in the routines of instructional practice. Students use their teacher's voice, facial expression, and body language as a compass for determining their proper position and direction in the world of learning (Dreeben, 1970; Jackson, et al, 1993). As computers assume a larger share of the instructional workload, this authoritative connection between teacher and student may be inadvertently weakened.

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[2]See McNeil (1986) for an extended analysis of the oppressive features of the culture of control.

Lortie's third point, that students are schooled in groups, adds yet another wrinkle (and obstacle) to computer use that is not present in other workplaces. The management demands of the classroom are enormous. Non-teachers sometimes fail to appreciate the administrative complications of managing a large group of youngsters. Parents, for instance, can one day plan activities for their child's three-hour, eight-guest birthday party with an attention to detail unseen since the Apollo moon landings--and the next day wonder why teachers routinize dozens of daily classroom operations and insist that all thirty-five children follow established protocols.

Unless configured in workstations, computers do not naturally mesh with the mechanics of group classwork. Hardware and software are typically developed to serve one user on one machine, allowing most educational software to function as well in the home as it does at school. But schools house large groups of youngsters. In classrooms where students outnumber computers (virtually all classrooms), the danger in computer-assisted instruction is that several children will be left as mere observers of those who command the keyboards. The impact of computers on the social organization of classrooms, in fact, is largely unknown. Some enthusiasts believe computers will draw students together in collaborative, democratic interactions (Apple Computer, Inc. 1995), but others theorize that they could lead to destructive forms of individualization and isolation of

students (Goodman, 1995). Good classrooms strike a balance between collective and individual needs, but coming up with imaginative, educationally inclusive ways for groups of students to use a classroom's few computers remains a difficult task.

The involuntary nature of schooling, fundamental immaturity of the children whom teachers supervise, and the grouped nature of most instruction combine to diminish the attractiveness of computers to educational practitioners. These conditions are not insurmountable, but they underscore the many ways computers make teachers' jobs more difficult, not easier.

Conclusion

To restate the title: Why aren't computers used more in schools? The essay has examined several reasons. The structure of computers' availability hampers their integration into classroom instruction. The prevalence of centralized computer labs, inadequate buildings and facilities, overinvestment in hardware, poor technological planning, and lack of trained personnel hinder widespread computer usage. Beyond these problems of infrastructure, however, are obstacles related to the essential nature of teaching and learning, and to the essential nature of teachers and students. The involuntary milieu of schooling, the immaturity of children as classroom workers, and the dominance of grouped instruction must be accommodated for instructional technologies to flourish.

Computer advocates have failed to recognize these constraints in their campaign to encourage wider use of computers, arguing instead that computer usage will grow when teachers teach a different way and students learn a different curriculum. And they steadfastly believe, to their own cause's harm I have argued here, that policy is the vehicle for achieving these ends.

The foregoing discussion supports a few simple recommendations for reforming the computer movement. The main conclusion is that computer advocates must separate their agenda from other reform agendas. In then presenting computers on their own merits to educational practitioners, the campaign to promote computer technology in the schools should stress three elements: 1) developing a strong technological infrastructure through investments in adequate school facilities, strategic planning, and trained personnel; 2) using computers to make teachers' current work easier and more efficient, not for redefining teaching; and 3) employing computers to increase student academic achievement, not for changing current ideas of valued knowledge.

We can make considerable headway in getting teachers to use computers in instruction if we stop approaching the task as one of getting teachers to do their jobs differently in favor of helping teachers to do their jobs as they do them now. This is hardly revelatory, for it describes the conditions that have favored the spread of innovations in other professions (Wilson,

1989). Once the use of computers is unhitched from movements to reform teaching, redesign curriculum, and abolish the public school monopoly and joined instead to efforts to make teachers' jobs easier and students more productive, this technology stands a much better chance of assuming a prominent place in tomorrow's classrooms.

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