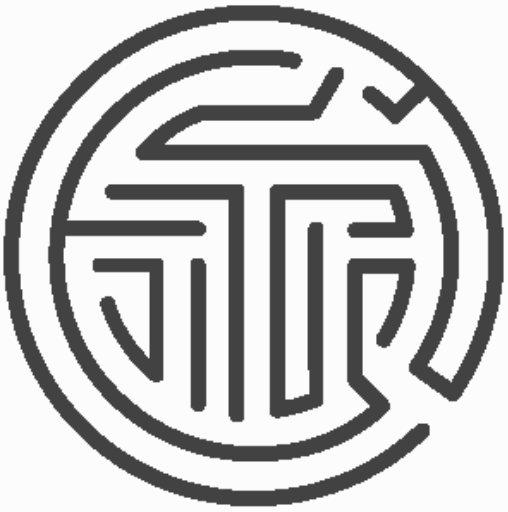
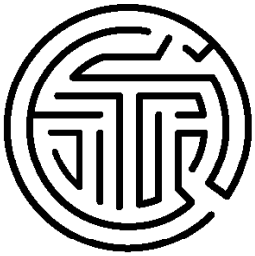


SCHOOL RESTRUCTURING AND THE ROLES OF TECHNOLOGY:

A TIME FOR MODESTY

CENTER FOR CHILDREN & TECHNOLOGY



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SCHOOL RESTRUCTURING AND THE ROLES OF TECHNOLOGY:
A TIME FOR MODESTY

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INTRODUCTION

Schools have been improved, changed, redesigned, reformed, and restructured throughout their history, yet, though they might not recognize the faces of the students in them, most nineteenth century teachers would probably still recognize our "changed" educational settings as schools. They might even applaud our expanded population as the true realization of the school as the great civilizer. But what our grandparents knew of the classroom manner at the beginning of this century is what most of our children, in most of our schools and classrooms know today—the teacher in front lecturing and directing. Most of our school reform efforts have been piecemeal and fragmented efforts rather than system-wide. Few have attempted radically new designs or complete paradigm shifts, and, as Raywid (1988) points out, "Widespread demand for restructuring is relatively recent and is often characterized as a second phase of the Excellence Movement of the 1980s."

Even modest school change requires great amounts of energy, focus and determination, and for good reason. Schools have been stable components of our society; they are conservators of our values and traditions. We must respect such powerful forces, even when we strive to restructure or improve them. When we tamper with our schools, we are tampering with our essential social and individual natures, and we are shaping the future. We should tread cautiously; we should propose with great modesty and restraint, but redesign and propose we must and should. Occasionally we hear grandiose proposals for change and panaceas are brought before the public unblushingly. Technology has been thus presented from time to time.

As our conversations about school restructuring expand during the 1990's, some common themes are emerging. Some of these themes are particularly significant for new designs that include technology: providing the time and resources needed for teachers and administrators to learn, think and plan together; designing for systemic change rather than piecemeal projects; integration of assessment and evaluation with curriculum; reduction of teacher isolation through the sharing of authority and responsibility and the creation of effective networks; blending research knowledge with wisdom gained from practice; changing teacher/student roles to foster collaborative, inquiry-based, and experiential learning.

But, there has been a decade of tensions about change in schools—what kinds of changes are needed so that more students are educated well, what are the mechanisms and interventions that most effectively turn the system toward improved outcomes, and how does this get paid for? It is widely agreed that improved education has as a vision students who can think and reason well throughout the disciplines, using knowledge flexibly as appropriate for new problems and new situations, who can skillfully use language and textual, mathematical, and technological tools; who are motivated to learn and who can work well in groups and teams. There is considerable tension over how to get there. For example, there are programmatic arguments over whether curriculum is best structured around complex projects and tasks that embed "basic skills", or whether "basic skills" training is to be taught separately and first. And for which populations? There is tension between reorganization around local decision-making about curriculum, standards, budget, and

state and national definition of standards and assessment procedures. There is tension around selection and use of technologies for learning: should resources be spent on "turn key" systems that are simply "operated" by teachers, or on the program development required to integrate technologies into the situations and tasks of individual schools?

Though we nearly always attribute our compulsion for changing schools to genuine concern for the welfare of our children, official authorization for change is more frequently aligned with economic interests, and schools are held accountable not for the stimulation of intellectual pursuits, creativity, or personal curiosity—from which alive and useful minds emerge—but solely for the immediate demonstration of marketable skills. School reformers envision changed physical structures, class size, more flexible time schedules, the introduction of wider ranges of program choice, the concentration of resources in schools with the greatest social or academic needs, making the curriculum more interesting or engaging, or altering the teacher's presentation of material. But, even in their newer forms, the schools are still schools, based on a particular view of mind and its development. Reform of schools is frequently confined to the movement of parts of the organization, shifting of curricular emphases, or the redirection of resources—material or human. Such changes, even the well-intentioned, are often isolated or superficial shifts.

The schooling that is deeply recognizable to us embodies a cultural heritage rooted in medieval concepts of the nature of knowing. Although often not explicit, much of our instruction today is based on the assumption that, for most intents and purposes, information is objective, stable, and is most effectively presented to students as fully formed. Knowledge can be destabilized or advanced only by those who have acquired the cultural credentials to do so—and the lives of these unusual individuals (predominately one race, gender, and class) become fixed objects of study. Mediators, usually teachers but sometimes some other sort of "realia" such as a book, a work of art, or a piece of music, convey stable truths directly to students. In an extreme extension of this stable, cumulative approach, some visions of the future have long imagined direct brain-machine links where knowledge is fed directly into minds through wires (Asimov, 1986, in Wilson, 1988) or chips (Brunner, l991). Authority is not to be analyzed. The student's job in school is to accumulate knowledge as it is presented. The teacher's job is to deliver information directly and to convey knowledge as it has been received.

Reform in schooling requires nothing less than broadly and significantly altering our common conceptions of mind and education, and of organizational and professional structures that are needed to carry it out.

The interesting and influential view that has been emerging has begun to blend current and past research in psychology and the cognitive and social sciences with decades of experience of progressive practice. While the emerging view is not fully harmonious in all particulars and details of learning processes, there are two robust overarching ideas that emerge as essential conditions for effective schooling. First, learners must be truly engaged. If students are to deeply and flexibly learn subject matter (or anything else), they must be actively engaged in exercising, querying,

refining their capacities most of the time. That means building, rearranging, testing, refining ideas—and objects—by probing, discussing, reflecting, debating, and so forth. Without deep and constant engagement that supports students to probe and refashion their own and others' conceptions of things, much of their learning is short-term accretion with little lasting or useful development or change of mind. Second, the qualities of the communities in which learning takes place are key. Students—and teachers—must be well-known to each other, and it must be safe for them to try out new things and to change. This requires new designs for organizational structures (size, schedule, interaction, and built-in mechanisms for self-criticism and perpetual development) that are quite different from most schools as we know them.

Technologies have key roles to play in supporting these new conditions of schooling—in our view they are likely to be essential. Research has shown that well-designed technologies can deeply engage students in learning, can effectively support collaborative work and the more complex interactions that are needed. But we also well know that technologies do not themselves bring about these conditions. There is no engineering solution to this set of complex problems of reform—making the best materials (hardware, software, video, whatever) is a key element, but will not itself revolutionize schooling. These resources must now be enlisted in the debate about and the design of reformed schools, not isolated in a separate room.

There are a number of schools, and school/research collaborations around the country and the world that are have been experimenting with how to best integrate technology through simultaneously altering curriculum and learning activities and aspects of school structure. It is long term difficult work—but so is all substantial change in the way communities organize themselves. But far more commonly in schools across the country, new media have been assimilated with school business continuing as usual. Many of these applications are simply electronic versions of direct instruction and do not support the dialog and interaction needed for active learning. Successful implementation has depended largely on the degree to which teachers feel comfortable with the mechanical components, the interfaces, required by the new tools rather than better or deeper understanding of the nature of learning or the media.

We will examine these two conditions in turn—engaged learning and qualities of communities—and some of the tensions that surround them in the soup of today's reform efforts.

New views of learning and school change

Some elementary and secondary school change strategies now begin with altered conceptions of the nature of learning and the making of knowledge, suggesting that students learn through the construction of knowledge based on inquiry and experience rather than the transfer of knowledge. Instructional models derived from the imaginative work of artists are being tried along side those of the research scientist, journalist, and anthropologist. In these schools, teaching is not an authoritarian activity but one that fosters exploration, discussion, experience and, ultimately, the creation of or shaping of meaning by the student. Such approaches see development as a gradual

movement toward sensitivity to multiplicity, flexibility, plurality and relativism. These approaches grow out of a greater emphasis on learning as a social phenomenon contributing to the socialization of the child rather than an emphasis on the functioning and operations of the brain or "mind." School is seen as in and of the world, and meaning is shaped by the student through experience and interaction with the world. Some theorists (Toulmin, Rieke, and Janik, 1979) describe thinking or reasoning as a kind of human or social transaction in which "reasons" are exchanged, their worth determined by their fit with the social situation. Such notions echo the thinking of Charles S. Peirce (1934, p. 407), "the opinion which is fated to be ultimately agreed upon by all who investigate, is what we mean by truth, and the object represented in this opinion is the real." In these critical transactions, "truth" is determined by convergence of informed opinion, not simple consensus, and is essentially pragmatic. To become educated, learners must participate in such exchange—"truth" cannot be simply received.

The notion that the world is irreducibly variable and full of multiple complexities is not easy for those schooled in either/or views of the nature of truth to accept. Cultural literacy lists and dictionaries present a simpler view. Pedagogy with room for interpretation and varied perspectives is demanding and threatening to notions of order and structure. Such pedagogy demands active inquiry, posing real-life problems, encouraging self-reflectiveness. Such pedagogy demands different kinds of work from teachers and places unusual stress on the support resources of our schools. Libraries, research tools such as computers, video recorders, and access to the outside world are larger parts of this pedagogy. Often missing from the constructivist formulas are notions of control, models, schema, or processes for monitoring and assessing the quality of thought or of developing a broad systematic view of the territory of a discipline. These are important and challenging pedagogical issues which must be debated as project-based learning is promoted and new technologies reshape resources and their access. Much of the work performed by students in such settings is interior work, not available for public scrutiny and often not structured around external sets of criteria. A student who has access to vast arrays of information and control of tools that allow the rapid reshaping of that information has great power. Some question whether that power can be well or appropriately used by students unversed or inexperienced in the "rules" of a discipline, the values of society, or the relationship of a specific project to the structure—to date—of knowledge. The MIT metaphor comparing education there to a student's attempt to take a drink of water from an open fire hydrant applies. Such education may well be wasteful of water, dangerous to students, and ultimately harmful to society. These are the terms of the debate, and the debate must be joined.

At the same time, others wonder whether we know enough about the ways that experiences in different media influence, or shape mind. Popular concern about the supposed dangers posed by television, computers and other electronic media to developing young brains has prompted a wave of rhetoric over the last several decades. Is the intellect reorganized by intensive involvement with computer-based technologies, and in what ways? What effect does heavy Nintendo use have on cognitive processes and children's cultures of play? (Honey, l991) Just as Plato worried that written text would destroy memory, it is now often asked whether our children are a generation of

"visual learners", and what does that mean? Are there new implications for educators and society at large?

One senses significant epistemological shifts, yet there are entire schools of reformers who appear to be unaware of them, and there are few conversations between educators and technology designers that address these questions. Making such considerations a feature of instructional design for all parties is important, but for those involved in shaping the ways that technology will help reshape schools, it is imperative.

Many schools focus on the ways that electronic media allow individual students to work in isolation, at their own pace, on skills relevant to the separate child. Research reports, however, that there is a great deal more cooperative learning going on than planned with students joining each other at the computer and creating their own interaction rules, and different work relationships among teachers and students. For example, Schofield (1991) studied a high school in Pittsburgh that used an intelligent tutoring system for geometry (Geometry Tutor) as a central component of some mathematics classes. The school was in part testing the software to provide information to its developers so that its design could be revised to be maximally effective for learning, and in part seeing whether this sort of computer support could improve their teaching of mathematics. In addition to interesting results that showed learning gains, Schofield reports some remarkable and unanticipated results concerning the social organization of learning and students' motivation. Students spent much more time on their geometry work, and wasted less time getting to class and getting started. The instructional role of the central teacher in the project shifted dramatically, from a lecture driven format in which the brightest students provided most of the responses and interaction, to much more individual guidance for individual students. In contrast to his earlier curriculum, the teacher spent relatively more of his time helping the poorer students. He also began to use different criteria for assessing progress—more attention to learning process rather than final answers. The incorporation of this technology was important then not simply for the merits of the software/hardware itself, but for how it reorganized the social components of the learning process.

In our experience, there are critical design issues that must be carefully articulated with each other for the effective use of technology for learner-centered schools. First, the software design itself must support productive inquiry by students and coordinated work with others. For example, the design of CSILE system (Scardamalia and Bereiter, 1991) has been carefully worked out with a school in Ontario to enable elementary students to do inquiry projects about topics like ecology. Supported by carefully designed software tools in the systems, teams of students work on particular questions and then share their work with others through a local area network that allows them together to create a complex common database about what they find. The curriculum helps the students to comment and draw on each other's work over time.

Second, it is extremely important to pay direct attention to the design of activities in which the technology is appropriately embedded. For example, the Dalton School in New York developed a

simulation called Archeotype which allowed teams of sixth grade students to conduct a simulated dig in a fictitious site in ancient Greece. The curriculum was crafted so that the simulation organized and launched the activity, enabling students to gather and store data about their "quadrant" of the site. They were pointed to resources throughout the school that could help them to interpret their "finds"—computer-based data, the library, people. There were four teams of students, each team studying one of the four quadrants; each team had to analyze the data they collected and develop an interpretation of the site that integrated findings from their individual quadrant. The final activity required the four teams to get together and come up with an overall interpretation of the site. The curriculum design thus embedded the technology resources in an activity structure that used them to best effect, supporting clear definition of the complex tasks required to learn historical interpretation skills, and making collaboration and teamwork central and meaningful.

Third, the design for staff development must be quite focused and continuous over a relatively long period of time. Curricular and social organizational issues must be embedded with the technical ones. For example, a public middle school in New York city decided to create an interdisciplinary curriculum in the humanities where technology was the focus (Brunner & Clarke 1992). The design featured collaborative teamwork for both teachers and students, and it quickly became apparent that considerable attention needed to be paid to the meaning and organization of collaborative work itself. Expertise in new forms of organizing classrooms cannot be assumed, and even the best software designs can only offer partial support, they cannot deliver learner-centered schooling.

Television, watched at home, is often a group activity with siblings and parents. A good deal more verbal interaction between students goes on than is usually anticipated with mediated instruction. Large databases and interactive discs allow the design of systems that are open to students' own interests and to serendipity in use. These capacities can be developed within teams that are organized to reshape schooling, but only if they are well represented and understood within the team.

Education is a Tough Business: Issues of community.

The work of the educator is hard, so much so that few school critics would accept employment as a teacher or administrator. The educational enterprise in the nation is staggeringly large and complex; the pockets of innovation and true reform are, by comparison, very small. In the face of such complexity, calls for change and reform, especially those from politicians, wealthy or remote corporations, and even university educators are not easily met. Efforts to meet them take predictable paths—greater focus on basic skills, additional programs that prepare students to enter the work force, change the curriculum requirements, raise standards. Such a view of change is additive or statutory.

Attention to theories, costly strategy building, and time consuming re-tooling are swept aside in the face of the overwhelming "reality" of universal and comprehensive education today. Sheer

volume, the perplexing problems of public health, poverty, nutrition, housing, changed family structures and unemployment converge in an often blinding social fog. We have long thought of education as our prime solution for such social problems, but the problems themselves press upon us faster than we can design or deploy solutions. We know that failure to educate now will increase the bitterness of our harvest later, but who can stop to think.

Those few who do stop to think and to create new schools find that change is possible, but they invariably work at change on a small stage. And change of this sort requires time, because we are asking nothing less than substantial change in people's assumptions about the nature of mind and schooling. Changing one's mind is disconcerting and confusing; consequent changes in organizations are painful and slow.

Those undertaking real reform in school find ways to carve out a new world for themselves and their students. They do not attempt to make change everywhere and all at once. Sometimes they take too long. Nearly always those looking at the larger reality say the reformers do not do enough; they work with selected populations; they recruit supporters that others do not have; they marshal additional supplies and resources. All these factors are used to explain away redesign successes, rather than to understand them. Seldom are they viewed as practices that others could learn or use. The history of innovation in education suggests that the ideas of "experts" and the experiences of other schools is critical, but they cannot be simply imported. Successful changes require each school community to itself become generative, examining and culling the experience of others in the process of inventing itself (Darling-Hammond, 1992). If we are to understand why restructuring is difficult, and, in particular, what roles technology can play, we must comprehend this reality.

If, as most school reformers say, small is better, and the four to five hundred student school is preferred, then a city such as New York needs 2,000 schools to serve its one million students instead of the 1,000 it now has. If predicted demographic trends are realized, one third of the nation will be non-white by the year 2000, implying a greater need for language instruction, greater pressures from poverty related social problems, and greater pressure for curriculum that accommodates various cultural histories. If, as school reformers suggest, coordinated school experiences are better for students, the fragmented system we now know that functions with little exchange or understanding among the units will have to be changed. It will not do, as representatives of one of our leading school reform groups do, to say that such contextual factors are irrelevant for school restructuring. They are not only fundamental to the reality that schools and school people face on a daily basis, these contextual factors are central to understanding the way people learn and organize themselves.

One approach to school redesign, the creation of schools of choice, alternative, or option schools builds schools that are nearly always small, with a theme focus. Interdisciplinary curriculum is common in these schools. Technologists who wish to play a role in the design of such schools must learn the vocabulary of choice. The school program must be attractive to students and par-

ents. It must be, in Maxine 's term, "engaging," or in David Cohen's term, "adventurous." Distinctive programs and more extensive movement out into the world beyond the school walls characterize these schools. They often make use of media such as video and computers to extend their curriculum, but materials that are created for mass audiences or standardized assessment are usually not appropriate.

In recent years, school reformers have placed greater emphasis on transferring the locus of control from central bureaucracies to the local school, even to classroom teachers, but changes in governance have not yet produced greatly changed instructional practices or learning conditions. The discussions of new school governance, school-based or site-based management and decision-making, usually include reviews of statements of school mission, but most energy is devoted to the redistribution of authority roles, the decision-making structure, and the social order in the school. The Effective Schools Literature, upon which much restructuring is based stresses improved school climate, the development of a clear sense of mission, and staff collaboration (Raywid, 1988). To join the conversation between restructuralists and technologists, these issues must become part of the thinking and vocabulary of technology designers. What role can technology play in redefining the decision-making structure of the school? How can technology be part of restructuring of the school's social order? What is the potential impact of technology on school climate? How can technology support the curriculum and activity structure that is needed for engaged learning? What can technology contribute to the definition and implementation of the school's vision or mission statement? Answers to all these questions immediately begin to come to mind, but the questions are seldom asked of technology specialists, and there is little public discussion of possible answers that bridge the technology and reform conversations.

It is in the area of mission building that content and curriculum issues are most easily addressed, but few of the governance approaches to school restructuring now address change from this point of view. A principal from a site-based management school said at a recent conference that it had taken his school five years to agree on the composition of the advisory committee. He was not optimistic that discussion of school program would proceed apace. Purkey, Rutter and Newmann, 91986-87, in Raywid, 1988) reported that in their study of 4,000 high school improvement programs, more than half the teachers in schools where principals report improvement programs underway were unaware of their existence.

Few of the restructuring schools spend much time discussing such things as constructivist pedagogy, inquiry-based science instruction, or integration of technologies in the service of envisioned change. At a recent meeting of educators that included instructional designers, not one presentation fully explored the changing role of teachers as shapers and constructors of the curriculum, and only one explored the active role of students in the selection and manipulation of content.

But experiments that combine these features are happening on a small scale, in some places. For example, in Rochester, NY., a public middle school has been collaborating with the University of Rochester and the Center for Technology in Education to create a model combining constructivist

pedagogy, technology tools, and a school structure organized around students in houses, teachers in fully interdisciplinary teams, and longer blocks of time for student work. The Discover Rochester project has been designed to support students who are less successful academically to learn thinking and research skills—control and heuristic strategies for learning and communicating. The primary focus of the curriculum is to explicitly teach general thinking strategies (question posing, data gathering, interpretation and representation, evaluation, presentation) while students investigate many aspects of their own community. The students together develop an interactive learning exhibit for other students and the community in HyperCard which includes text, audio, graphics, maps and music. Rather than moving among separate subjects for 50 minute periods, students spend all of their time working on interdisciplinary projects in one self-contained room. In order to reorganize their work in this radical way, a kind of apprenticeship model was developed for the teachers. The teaching team collaborated with the curriculum support and research team to design the curriculum, and the outside groups acted as mentors in the classroom to carry out some of the more complex tasks until the teachers were prepared to assume full control in the restructured setting (Carver, 1992).

This complex model has been designed and shaped to the conditions of this school. Are there "correct" procedures or organizational patterns that assure the effective and efficient delivery of instructional services to children, and what degree of flexible fit to individual schools is needed? Are these the things that constitute good education? Are all children being well served by these? If not, what do we say to the parents of children who do not do well—read well, compute well, navigate our society well—when they complete our schools? These are the terms of the school reform discussion. The stakes are high for children.

And the situation cannot be "fixed" simply by getting the curriculum materials right—albeit this is a key part of better schooling. From the history of innovation we can interpolate that what is also key is defining and designing new forms of participation in generative educational communities. Teachers need to be prepared to create and sustain these communities for in-depth subject matter learning; students need to be unaware that school was ever any other way.

Technology

Over the last fifteen years, the infusion of technology into K-12 education has taken a familiar and often disappointing course. Computers and other media in new shapes, sizes and configurations, communications systems, and distance learning capacities have developed more power exponentially and increased flexibility at a dizzying rate. Yet emerging technologies traditionally stand restlessly at the school gates for some time. In the meantime, they are immediately noticed and enlisted by industry, the military and the entertainment industry, who are keenly attuned to new developments. The military, industry and business have been spending billions on technology-based programs aimed at specialized skill training (Adleman, no date) There have also been several large scale efforts such as Project Athena at MIT in higher education. Shopping mall video game arcades house far more sophisticated applications of new visual and computer technology

than our classrooms. Military personnel learn to fly and maintain the most advanced aircraft using interactive technology. Many college foreign language programs are heavily technology-based. The entire visual collection of the MIT school of architecture is available to every student, on-line, and over one hundred professors at the school have created on-line versions of their courses. Engineering firms conduct much of their professional staff development through television-based distance learning systems.

There are wonderful examples of both software (including emerging multimedia applications), and of schools that have integrated technologies well. But many years into the computer revolution, good uses of technologies, and the enlistment of technologies in the service of reform is far from the norm in K-12 education. While advances have been made in the three major factors (development of materials, widespread installation of hardware, teacher development), these have not broadly penetrated the work of educational reformers. And solutions in any one of these areas, in isolation, is insufficient to thoroughly enlist technologies in the reform of schooling:

The development of powerful and appropriate software for student centered learning.

Significant progress has been made especially in science and mathematics. There are wonderful examples of powerful, creative and effective programs. For example, Technical Education Research Center (TERC) in Cambridge, Mass. has created a generation of science software that is creatively designed to motivate and engage students in inquiry in science and mathematics. Their designs for microcomputer-based laboratories, for instance, combined clever engineering of inexpensive sensors for gathering physical science data (temperature, light, sound, pressure, motion and so forth) and directly representing it in well-designed graphics on the computer screen. But compared with the investment made in other sectors, the development of technology-based materials, or hardware, for K-12 education has been quite small. There has been very little investment in the humanities.

One of the authors, in attendance at a major technology conference, listened to two simultaneous and adjacent lunch conversations, one a discussion of a $50,000 school-oriented interactive disc project and the other a $10,000,000 industry project that was no more complex in design, but was far more lucrative. Small wonder where the attention was paid. As the nation moves toward reduced defense spending, there are rumblings of massive amounts of funding that may shift to education applications, the creation of “turn-key” and “test-bed” designs for schools that employ the sophisticated soft- and hardware previously reserved for “star wars.” and new strategies for networking schools to other of our society’s information producing and using institutions. In one recent meeting, the phrase, “scores of billions of dollars” was used, calling up an image of a new technological tsunami bearing down upon unsuspecting educators. The danger, of course, is that the tidal wave may deposit unimaginable collections of equipment at the school house door, never to be seen or used productively again. School reformers learned long ago, for instance that teachers do not take kindly to “turn-key” curriculum designs. Such designs are usually equated with

"teacher-proof" approaches. The assumption underlying such development has been that by making "foolproof/teacherproof" materials we isolate the crucial problem and in one sweeping gesture engineer a solution for it. It has been regularly and routinely shown that even the best materials have at best mediocre effect unless they are orchestrated well in classroom and school organizations. Yet the materials-alone-will-solve-the-problem assumption is pervasive.

In a Horace Mann Lincoln Institute 1970 evaluation of the Experimental Elementary Program, some participating schools that received $1 million each in equipment and materials for their new technology centers were found to have stored all the equipment in hidden bins underneath the auditorium stage. Other participants were, of course, making good use of the technology; the difference inevitably being coordinated curriculum planning. Such planning is becoming a hallmark of school reform efforts and should be a key criterion for judging efforts to integrate technology with reform. It is not that the billions of dollars are not needed, nor is it that they cannot be well used. We maintain that integrated design and planning teams must work carefully to avoid the mistakes of the past. We should not be rushed to implementation to satisfy economic or political interests.

As schools move away from standardized comprehensive school designs toward more locally designed schools, locally adapted or created curriculum and away from standard texts and tests, there will be fewer incentives to design mass market products and software. As Kerr (in Baker, et al, 1989.) points out, the work of educational technologists has been, "...increasingly distanced from the work of ordinary teachers in the public schools." Ordinarily, they have not sought to nor have they been sought out to participate in the reform debates. America 2000 and NASDAC are among the first major redesign activities to at least claim to make a place for technologists at the table. Whittle's Edison Project, bound to include different uses of technology, is building its own table, and is likely to establish criteria for cost and delivery effectiveness that are closer to those used in business settings, not necessarily those that will promote the learning conditions that are needed. But, for the most part, technologies have simply bypassed the traditional educational research and development establishment in finding their own paths into the learning lives of our young people and children.

While there are examples of good materials, they are far from the norm, and the development process is not sufficiently and strategically supported to appropriate these wonderful examples of both products and product development processes as the canonical approach. Too often, technology products are hastily based on the way things-have-always-been-done (e.g. multimedia products mimicking textbooks). They are also not regularly designed to task specifications for new kinds of schooling, and some of the barriers to technology use are fundamental and are not easily changed. Even with the rapid deployment of "notebook" computers, books are still easier to drop in one's pocket and read in most settings. Computers are not as flexible and do not have the feel of print media. Film and video materials cannot be previewed as quickly or as easily as print, and the costs still are prohibitive, but designers are providing us with new easy to use, inexpensive, powerful sources of information in flexible formats that are interactive and supportive rather than authoritative.

The Federal government established an Office of Technology Transfer in an effort to reverse the flow of both funds and product development and direct the products of military investment back to the schools. At the same time, as major universities develop integrated technology support infrastructures for their campuses, we find that movement back down the line to smaller colleges, public schools and the general public is inhibited by costs and the sting of past unpleasant experiences. Teachers, school administrators and policymakers have become cynical, leery of the high costs, the unfulfilled, overblown promises of earlier times. The public has been confused. And the "transfer" metaphor is often inappropriate. The transfer view ignores the essential collaborative nature of deliberating, designing, and infusing technologies for the overall goals of reform. Not only are new, increasingly powerful and flexible technology-based tools and resources needed now in schools, but new participant structures are required to make them part of the overall redesign of schools.

Most schools now have a hardware base that makes computers, at least, available to most students.

This is not a small investment. However, few schools have staff sufficiently prepared to take advantage of the hardware. Consequently, few students yet have the kind of access that is needed to make computational technology a learning tool. Even in those schools with an installed base, they cannot keep pace with the rapid hardware developments that are eagerly anticipated by industry, entertainment, and the military; few have the capacity to upgrade. Some schools make valiant, even if unguided efforts to incorporate technology. At the poorest end of our educational spectrum, on a junkie filled street in Harlem, there is a school that is labeled a SURR school. These "Schools Under Registration Review" have long standing records of academic failure. They are identified by the New York State Education Department as in need of close supervision and constant monitoring. They have three years to turn themselves around, but they must overcome almost impossible obstacles. For example, the contract with the United Federation of Teachers in New York City allows senior teachers the right to transfer to a school of their choice when vacancies occur. The same contract has allowed teachers to be hired who do not meet state or city requirements for college training in education. These Temporary Per Diem (TPD) teachers may work while they take the necessary courses to meet the requirements. They are usually young and inexperienced. These two factors have meant that senior teachers frequently opt for schools in safer, more wealthy neighborhoods and that unusually large concentrations of TPDs work in inner-city schools.

In the case of our SURR school, a staff that was 95% inexperienced TPD teachers was charged with turning the school around. As it happened, one senior school staff member contacted a local foundation and secured a grant that allowed the purchase of computers and some rudimentary software. No one in the school, including the senior teacher knew much about computers, not even what brands to choose from. They knew even less about instructional software, but they saw the possibility for insuring that the students would receive at least minimal levels of reading instruction. There was clear lack of faith on the part of the school administration and senior staff

in the abilities of the TPDs to teach even beginning reading skills. They were taught instead, how to operate the computers and run the software before they were given staff development in reading instruction. The senior staff member learned about computer assisted instruction on her own, just ahead of her teachers, and the software distributor was leaned on for additional training. The first class to spend a year with the program also became the first class in the school's history to score at grade level on the state required reading test.

One might find some reason for cheer in this account, but the economic forces of the city and a new UFT contract that ruled against the hiring of TPDs combined to send shock waves through the school in the summer of 1992. Fiscal crisis-inspired cutbacks and the offer of early retirements to save money on senior positions left the school with only five regularly licensed senior teachers for the fall opening. All TPDs were told that their jobs were eliminated that summer. A last minute compromise brought the TPDs back for the new school year, but stability has not been established.

Here we have a school in the worst of circumstances, ordered to improve, to redesign, to restructure, to find some way to do a better job. The staff, not knowing where to turn for help, chose technology, but for the worst reason, as salvation from poorly prepared teachers. They also chose a rigid and inflexible instructional strategy that required lock step performance by all teachers and students alike. The students performed well on the required test. They, their teachers, their parents and their school are proud of them. But opportunities for far greater growth were missed, primarily because there were no opportunities for conversation with designers who know both technology and schools. The economies of the schools forced this school to outside resources, but those sources assumed knowledge and experience on the part of the school personnel. They too are probably proud of the accomplishments of the students in "their school," but the students have missed many opportunities, opportunities that could have been gained with integrated program design.

A view toward change on a human scale: the case for professional development.

There has not been sufficient, or the right, investment in people. The kinds of changes being contemplated and tried require teacher and administrator support far beyond the traditional in-service "training" designs and preservice programs. College preservice education is limited by the experience the professoriate brings to the classroom. Few have extensive practice using technology in their own work and are unable to convey such thinking to their students. Projects designed to change this situation such as those funded by the Fund for the Improvement of Post-Secondary Education aimed at expanding the technological vocabulary of professors are little-known in teacher education circles. Colleges, competing for students are unwilling to add additional credit requirements to their degrees because these credits either take additional time, cost more, or take time away from existing classes. One college recently "met its obligation" to provide an introduction to technology for its future teachers by adding a one credit course. This addition required a major internal fight. The changes required are long-term, complex, and require deep changes in

many peoples' beliefs about schooling and the tools that support learning. Long-term, consistent visions and support for changes must be combined with organizational structures that integrate the reflective and interactive procedures that allow people to assume responsibility for inventing themselves.

In our view, places are needed where designers, artists, entrepreneurs, visionaries, educators, child-care specialists, and research scholars can come together to plan, share, conduct design experiments and build an assessment and accountability framework that supports a constructive role for technology in school restructuring. It is a time for talk, for discussion, for learning each other's vocabulary. The task is none too easy, given the confusion about simple definitions of terms that continues within the school reform world. With a few exceptions—large scale wiring, satellite transmission, some remaining compatibility issues—the hardware and software components are manageable. Human interaction issues remain to be solved. "Techies" still intimidate educators with their jargon and the creation of mysterious and protective auras to be penetrated only by initiates. Knowing the differences between a "school choice advocate," a "school governance reformer," and a "curriculum revisionist" is not an easy task for instructional designers who are removed from educational reform circles. Educators need to engage technologists in the exploration of constructivist notions of learning and pedagogy. Designers of schools must work side-by-side with technology designers if we are to move beyond the use of media simply as vast reservoirs of information to substantial supports for reflection and engagemen.

Brunner (1990), our colleague at the Center for Children and Technology, says that to integrate technology into the school curriculum, educators must bring new skills and knowledge to the work. It takes teachers who are "technology- and visually-literate," who are familiar with the options different media present, who know how to select images and manipulate them, analyze and create them, who are comfortable with non-linear thinking. Many schools and school systems are moving toward interdisciplinary curriculum designs, in response to the pressures brought by rapidly increasing collections of information and knowledge in the disciplines, multi-dimensional demands placed on the schools by society, and increasingly holistic conceptions of how knowledge and society interact. The move creates a new demand for greater understanding and skill in the use of the major symbol systems of our culture. Technology-based instruction can facilitate such instruction, since it embodies multiple symbol systems. Educators and designers have not yet produced a significant amount of appropriate interdisciplinary software for school use. Such design work requires careful interpersonal communication, for there is so much ego involvement in disciplinary identity. The work must be designed to consider human interaction issues and must encourage new respect. It must be conceived on an intimate scale with simpler controls and easy expansion. Flexibility must be a key design concept. We cannot afford more meetings from which the two sides exit mouthing criticisms of the other's inadequacies.

For example, the Media Workshop at Bank Street College (Wilson,1992) is a pilot project that was undertaken by the Center for Technology in Education, the School for Children, and the Bank Street Graduate School to test a new model for combining the talents needed to create a new kind

of capacity for technology integration and curriculum design within a school itself. It is based on the assumption that in order to substantially create learner centered schools, teachers must be deeply engaged in designing, critiquing and revising their own practices. The school must have the capacity to design and adapt materials to local visions and needs. The Workshop combines curriculum and media design with educational practice, and research in a unique configuration. The Workshop is literally a room that contains learning technologies of all sorts, electronic and nonelectronic (computers, video, books, art materials, videodisk, modems, scanners, and so on). In addition to the materials, the guidance of curriculum and media designers is provided to teams of teachers who use this expertise to shape materials to their own requirements. Eventually the Workshop will serve as a site for other schools to learn about this capacity, and to be the hub of a network of resources to build and support satellite Workshops in other local schools.

Technology development and integration into education thus must be closely aligned with solving problems in the classrooms and the curriculum for student-centered learning, and in the organizational tasks of the school.

This kind of coherent approach to design and integration for learning and organizational problems—taken together and comprehensively—is almost unknown in schools as we know them. The tendency with technology integration over the last decade has been to isolate and solve the technical problems (physical space, wiring, technical specialists, teaching people hardware and software fundamentals) independently and with much greater vigor and investment.

It appears that the same approach is likely to characterize the widespread incorporation of distance learning and telecommunications technologies that are the next big technology "solution" waiting at most schoolhouse doors. Attention and investment are heavily focused now on the technical infrastructure—basic and essential. But again, very little attention is being given to how these exciting capacities will become well-used in schools, or well-used in school change. Few are examining what can be learned from a decade of research on the use of telecommunications technology for learning.

Some projects such as The Four Seasons Project are working toward the integrated use of distance technologies to support teacher work at remote sites around the nation. This project, housed in the National Center for Restructuring Education, Schools and Teaching (NCREST) at Teachers College and supported by the Center for Children and Technology (CCT) at Bank Street College provides for collaboration on problems of assessment for some of our leading school restructuring organizations—The Coalition of Essential Schools, The Foxfire Teacher Outreach Network, and Project Zero. Fostering professional conversation among the participants and assessment specialists is the Four Seasons Project's main activity, to be accomplished through an electronic network, teleconferences, the exchange of a variety of technology-based documents, records, and products, and an annual summer institute. People in schools seldom have the opportunity to learn from each other in regular and sustained ways or to take advantage of the work going on in the

research and development community. With sustained communication among the schools, they can take advantage of the approaches being tried elsewhere, better reflect on their own practice, and participate in the setting of standards for student work. Approximately forty-five teachers from seven states will participate. They have demonstrated success in the community-based, experience-based, and learner-centered instructional practices of the partner organizations and are skilled in the use of authentic assessment techniques. They are also interested in sharing and refining their practice. Many of them have begun to use video, satellite communication systems, interactive media, multimedia activities, exhibits of student work, cultural journalism, and the various arts in their instructional and assessment activities. Support will come from the NCREST staff and from the CCT team of instructional and technology designers all working as part of the design team and all networked through computers.

The program for the Institute will include sharing of assessment practices and activities, expert consulting on the available options for enhancing assessment, discussions of the policy implications of our work, work with technology design specialists on the uses of technology in assessment, cross-discipline sessions with artists and others working in the fields of business, sports and theater about their assessment criteria and rubrics, and training for participants in the use of networking technology. This group will become a "national faculty" of teachers who can work with their colleagues to support valid assessment activities and prepare materials and presentations for use in the policy dialogue on standards and accountability. Sharing materials and conversing electronically during the school year will be an ongoing activity for the participating teachers. They will conference with assessment specialists using the ASCD Access network and will share videotape and graphic materials, as well.

The Four Seasons project envisions the use of technology to document authentic assessment strategies and resulting knowledge and to disseminate them to other interested groups and policy representatives. The integration of technology into this project is crucial for bringing the partners together and for moving forward the school restructuring agenda.

The need for new research designs and emphases.

We have numerous studies of the mechanical aspects of technology use—the ways that computers can serve as tools for learning or instruction; the economies of television usage; the role of multimedia simulation in school pedagogy; the packaging of integrated instructional systems. To some extent, these emphases derive from early beliefs that technology would "teacher-proof" or "student-proof" our classrooms and the work of learning. By removing the exigencies of human frailty from the structure of instruction, which some believed technology could do, we would move to a mediated school utopia. Researchers, following the same logic, initially searched for causal relationships among the tools, the instructional strategies, and student performance, with educators and policy-makers eagerly awaiting positive results. The search produced meager and often contradictory results; "technology" is not a unitary object or category that can be coherently treated as an independent variable. Spectacular learning results in experimental laboratory studies were

not uncommonly followed by little gain in field studies in classrooms. "Technology" interacts with complex combinations of pedagogical and organizational variables in real world use. When all was said and done, the general consensus was that, at best, the cumulative research showed neutral effects. Some researchers reported that teachers were intimidated by the complexities of machines, that teachers feared replacement by technologies, or were demeaned by the notion that technology might do what teachers were prepared to do.

Recent investigation, however, has begun to turn research paradigms on their heads. Researchers are seeking the kinds of human interaction patterns, thoughts, and program designs that foster more holistic views. Ethnographic studies have become commonplace in education. Teachers and other practitioners have taken research scientist roles in both the design and conduct of research. Research groups such as that housed at the Center for Children and Technology are seeking affiliation with a wide range of schools and practitioners. The cases briefly described in this paper illustrate both the strategy for integrated research and program development and some of the critical issues that face school reformers and technology design professionals.

The Policy Environment for Technology in Restructured Schools.

Thinking about educational policy is frequently restricted to deliberations about the allocation of funding and resources, the structure of regulations and requirements, the certification of professionals, and the creation of large scale strategic plans. This thinking follows patterns that lead to the kinds of engineered solutions to school problems that have characterized our past efforts to create technology-based education—short term programs, massive investment in hardware, little sustained attention to human issues such as professional development and more appropriate roles, and collaborative design activities. Such thinking usually takes place in wood paneled board rooms in seats of government far removed from the school or classroom.

New Roles for Everyone.

Teachers are seldom part of the deliberations, usually being treated with the same implied condescension they receive in most settings. They are, after all, as they frequently say, "only teachers." When they are brought in, they have little experience with policy formation as we know it and often lack the skills of public debate. As we have suggested elsewhere in this paper, effective school-oriented policy deliberations must shift from financial and material issues toward human issues. These shifts are radical in nature, though in practice, they are relatively simple to achieve. If we want policy that drives reform strategy and practice, then we cannot settle for business as usual in the policy rooms. We must add new players—teachers and other practitioners to the discussions. We must devise ways for them to play new roles—practitioners/policy-advisors and policy-makers—adding value to their experience and to our discussions. We do not want teachers who are changed to function as policy-makers, but a new kind of person at the policy table. At the same time, we must expand the nature of the roles played by all policy-shapers. We do not want simple decisions about resources, time, or space; we want program/policy. We want policy in context with the needs of practitioners guiding the organization and delivery of resources. For policy

to be effective, we must find new structures for participation that engage classroom level and technology design practitioners in the shaping of policy. Their voices and their concerns must not only be heard; they must carry decisive weight. Policy discussions must not be limited to the usual time, space and money considerations; they must expand to include purpose, and views of school mission that enlarge our practice.

Professional Development.

When asked, teachers frequently request more time. Time for teachers almost always translates into class load and class size. But these very tangible aspects of school life translate more generally into energy, the energy needed for contemplation, planning, communication with peers, for simple thinking. Teachers know that they cannot teach the number of classes and students assigned to them and prepare adequately. When they are also asked to prepare for change or when they are attempting to make change, they require even more time. When resources are delivered, however, time is not usually one of them, or it is doled out in such small dollops that it will not suffice. Sheingold and Hadley (1990) found that successful teachers spent an average of five to six years reaching the proficiency levels required to integrate computers into their curriculum. Human capacity building, professional development, building supportive professional networks of practitioners are priority resources for all school restructuring, but are especially crucial for efforts that integrate technology. Colleges and universities that have primary responsibility for pre-service teacher preparation are not willing or able to expand their foundations programs to include sufficient time to learn about technology. In-service professional development is seldom structured to allow enough time for real proficiency building. For such development, teachers would have to be out of their classrooms and compensated for long periods of time, additional or replacement teachers would have to be provided. These are legitimate policy issues, but they are seldom addressed as such.

The single most important support that we can provide for the integration of technology into school practice and school reform is the provision of new forms of professional development, both pre- and inservice. The problems attending these activities are among the more intractable in education, for policymakers must consider local jurisdictional issues of the first magnitude when they begin to shape teacher preparation criteria and practice. Our options are not very attractive. We can wait for a new generation of teachers to emerge from the pool of children now acquiring technological literacy in the playrooms at our shopping malls. We can continue to allow a few teachers who are interested but untrained in technology to acquire their skills serendipitously. We can install tech centers and provide a few hours of staff development for a few interested teachers. We can hire technology specialists to staff computer labs in our schools and ask them to conduct some staff development sessions for other teachers. We can add to the cost and time required for teacher education by adding new courses and credit requirements in technology. Or we can integrate our efforts by building design teams of teachers, administrators, college professors, technology designers, information specialists from business and industry, and librarians who are charged with the creation of new ways of building integrated professional development into the fabric of school restructuring.

For the most effective professional development, we need more hands-on work in which teachers, administrators and technology designers learn about each other's skills while they work together to build new school curriculums, new school designs, and new applications. On-the-job training can be especially effective when complex skills are involved, skills that can best be understood when seen in real world contexts. The kinds of classroom, workshop or laboratory professional development that has been typical of our technology integration efforts is a kind of least-common denominator approach that reduces very complex reality to the teacher equivalent of a sixth grade reading level. Such sessions do disservice to their content and the participants. Any approach that respects the human issues that we think are so important for school restructuring, must also respect the complexity of these issues. This means new kinds to "technology" specialists than those common in schools systems today; these new specialists must emphasize the design role—helping teachers to think about the use of technology in reorienting curriculum rather than emphasizing technical support. We need forms of professional development that support the kinds of social networks required in our new school structures, and these forms must support collaborative activities. As we have argued, technology can play more effective roles in the restructuring of schools if we unite social and conceptual issues with policy formation.

Large Scale Funding, Small Scale Applications.

A major national organization is currently seeking applicants for a new technology in education initiative. Policy-makers have determined that "billions" are needed and available through this organization to move technology into schools in a massive way. The problem is that the organization only wants to work with a "turn-key" program. Our experience has shown us that there are no such programs in educational technology. It is not that the schools do not need these billions of dollars to implement change, especially if the changes are to include technology. The point is that the creation of the policy that established this initiative did not engage those who have to carry it out. Teachers cannot implement a turn-key program because they are not prepared to do so. They do not own it and cannot be expected to understand its principles. There can be no "Teacher-proof" instructional programs. There can be large scale efforts designed in collaboration with teachers, technical specialists, industrial planners, community representatives and our policy-makers should make policies that promote such efforts. But we should also be seeking new models and the policies that support them that do not require creating massive solutions or perfect materials. In many cases, we do not even seek final products, but inquiry-oriented approaches that begin a process but do not define or confine it. We want technology that supports a curriculum that gives access to information but does not predetermine what students do with it. The small application tailored for the local school or school district should be as appropriate a model as those that attempt to profit from massive scale.

Access and Equity.

Among the smaller scale applications, we need materials and school designs that address access, diversity and equity issues, the interests of underrepresented minorities and that fill culture-based curriculum gaps. If materials developers cannot be lured by economic forces to produce in these areas, public support for design projects addressing these needs is required. The materials we need are not simple additions to the curriculum canon, but new semantic nets, socially derived, that contribute to the cognitive and social development of all children—boys and girls, physically challenged, ethnically diverse— and add to the internal parsing systems education is expected to provide for all.

In addition, access questions tend to be defined in terms of access to machines. This is certainly basic and critical. Policy that creates a kind of "learning stamp" for economically depressed populations would provide a means of exchange that could purchase time with hardware and software. Public library programs that lend software and provide equipment for on-site uses would open new worlds to large segments of our communities, just as the public supplying of books did for past generations. But also critical is access to learner-centered education that incorporates technology. We need publicly supported programs of review, information exchange and on-line software distribution that are tailored for parents and for home use. Such a program would allow parents access to independent reviews of materials for their children. They now depend, as do our teachers and schools, on vendor produced sales information with its inherent biases. New electronic collections of software that could be leased and accessed through our on-line networks and services would greatly expand the scope of our nation's general population's access to electronic information. How the machines are used is vital, and the activities in which technologies are embedded now to be different for different populations of students, along predictable lines.

Change the Boundaries; Change the Walls.

Policies that foster new ways of thinking about schools and school buildings make it possible for new configurations of community resources to be shared We should insist that public utilities and services such as cable, satellite systems, and fiber optics be built into school building plans. Policies that not only ease the way, but that motivate businesses to establish collaborative technology development with educators would help. We need quality learning environments for new schools, and these environments should not stop at the school walls. The restructured school exists in a broader social picture, one that not only recommends the joining of information bases from hospitals, libraries, colleges and universities, it demands such integration. Our current technology allows such sharing and plans are for the major access to be given to businesses, research institutions, and the military. Policy must assure that schools are allowed to plug in to NREN and its component networks.

At the local level, the installation of fiber optics networks, cable television franchise operation, and satellite delivery systems must include school uses in their design. Most city plans include, at least, the rudimentary elements of such inclusion, but we have seen that schools frequently are

last in line for services. A single drop line in each school is only a beginning. Adequate service requires much more access and more participation in planning. Some plans that include thinking of school buildings as community service centers after school hours and on the week-end move toward wider and more equitable distribution of technological resources. Sharing the use and costs of our technology infrastructure among many institutions is necessary. The models created in these sharing centers can contribute to the school reform effort by helping schools explore changed space, use, and activity patterns. Opening the schools to the larger world can help open the larger world to our students.

Redefining Turf.

Traditional school structure, dictated in part by curriculum and credentialing regulations and in part by the professional territories staked out by discipline specialists fragments school faculty and compartmentalizes resources. The resulting turf battles are endless and debilitating. When there is not enough room for everybody at the trough, the battles become devastating. Policy change is needed that reflects a radical rethinking of the nature of professional education and that creates a covey of new roles. We have discussed changed administrator and teacher roles, but such changes will require high levels of cooperation from the unions.

While much of the current school restructuring dialog focuses on changing roles and responsibility levels for teachers, school administrators—principals, superintendents, supervisors—must be prepared for the integration of technology. Many school-level efforts fail because the administration does not adequately understand the issues or support the plans. Professional development for school leaders is needed. National conferences, possibly convened by major policy groups such as the Council of Chief State School Officers or the Education Commission of the States, and special leadership seminars run by professional organizations are needed.

Universities need to be encouraged to seek out long-term field relationships that call for their faculty to invest heavily in new design roles. Researchers need to be encouraged by funding and program policy to play a more interpretative role in educational systems, joining teams that create new strategy rather than just standing outside the process documenting and observing. Policy changes that encourage interdisciplinary structures and teams that cross traditional lines could foster higher levels of collaboration, support coordinating frameworks, and result in more complete integration of technology. Plans to integrate technology into the social studies or English curriculum are not compatible with a structure that places most of the technology in a separate technology lab run by a "technology" teacher. The models we should emulate are perhaps similar to those of the language interpreter or a variation on the agricultural field agent. They would serve to channel complex information directly to the school or classroom. Our revised model would make them members of more elaborate teams rather than the isolated and independent figures. These interpreters would also serve as key figures in the communications networks we envision. They would be the conference facilitators.

Networking.

Teachers, though they seem to have become used to it and perhaps even to enjoy it, are so isolated from their colleagues that their conversations are perfunctory. Our work suggests that in addition to more collaboration in real tasks within schools, teachers also need stable, regular, and continuous interaction with people dealing with similar problems in other schools. They need new kind of collegial networks than are traditional in our educational system—networks among peers and mentors that more resemble those in research and policy communities. Face to face, real-time conversations are needed and most valuable, but our finances do not allow much time for face to face work. Telecommunications technologies appear to be a natural resource for this need. The technical and social infrastructure can be designed to this problem. We should also establish other communication networks for teachers. We have not yet determined the kind of balance needed between electronic and face to face contact, but we can begin the design effort. Good teachers are idea people who need contact with a larger peer community to develop their ideas. "Star" teachers get out to conferences and other settings, but even these teachers are often treated as subservient participants in courses or seminars conducted by experts. Public policy should insist that schools and teachers have direct access to the new electronic networks that are being designed for the nation. These networks should not be reserved for an elite group of researchers and scientists. Again, if educators are not at the table as these designs are prepared, they will find that no access exists for them.

The policy changes that are required to support the integration of technology with school restructuring are not different from those changes needed to support school restructuring with our technology. Good schools need to be freed of meaningless regulation. They need support for professional development. They need changed time and space patterns; they need flexible networking among professionals. They need their teachers and administrators to work directly with other specialists in collaborative teams. They need a forceful shift in focus from the mechanics of schooling to the human concerns of schools, a shift, in Ann Lieberman's words, to a focus on the "meaning of work" from a focus on "what works." Such a shift requires policy support for the creation of communities of learners and leaders. These communities will draw on the strengths of multiple perspectives and collaborative efforts focused on growth and change. The communities will be self-renewing and perpetuating, interested in capacity building based on critical reviews and the sharing of ideas about learning, practices and products. These communities will integrate technological tools that help overcome space/time separation, and they will incorporate changed roles for all participants to ensure the distribution of responsibility, skills, and knowledge.

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