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ABSTRACT

Inspired by the format of and discussion at the 1984 conference, the conference described in this report examined the question of how the computer might stimulate teachers' learning and under what conditions that stimulation might encourage reform. An overview briefly summarizes the presentations. Several conference themes grouped under the headings of Opportunities to Learn and Conditions for Learning are then discussed: (1) computers may provide teachers with opportunities to grow through pioneering and tinkering; (2) computers may prompt some teachers to become fresh learners of their own subjects; (3) the computer may provide teachers with the opportunity to learn about learning; (4) computers may prompt some teachers to revise their teaching style; (5) computers may prompt teachers and others to engage in a critical examination of the regularities of schooling; (6) teachers must be partners in innovation; (7) teachers need time to learn; and (8) teachers need collegial advisors. It is concluded that teaching with new technologies can create powerful opportunities for teachers to become eager students, although this new learning is unlikely to lead to meaningful school change if it lacks a supportive organizational context. A directory of participants is appended. (25 references) (MES)

# TEACHER AS LEARNER

# THE IMPACT OF TECHNOLOGY

## Conference Report

## May 1986

Harvard Graduate School of Education
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# PREFACE

Good conferences, like other productive intellectual endeavors, have progenitors. This conference's lineage can be traced to a recognition that, despite a habit among some reformers to think otherwise, the fate of instructional innovation rests ultimately upon the decisions of teachers(1). This recognition has informed the collaborative structure of the Educational Technology Center and has influenced each of the Center's major conferences — especially the immediate ancestor of the conference reported here. Called "The Computer as a Teaching Tool: Promising Practices," it was held in July 1984, and examined teaching applications of the computer in several subject areas(2). In doing so, it reversed custom by focusing first on practice, then on theory. Teachers presented case studies of their own work, then commentators analyzed these presentations with the help of appropriate theory. Partly as a result of its novel format, this earlier conference sparked an idea: that the power of the computer to achieve school reform may lie chiefly in its capacity to stimulate teachers' learning. The conference reported here, held in June 1985, scrutinized this idea, asking how the computer might stimulate teachers' learning and under what conditions the stimulation might in turn encourage reform. The result was a dual focus: on teachers as individual learners and on the workplace conditions that their learning requires.

## CONFERENCE OVERVIEW

In her keynote address, Patricia Albjerg Graham, Dean of the Harvard Graduate School of Education, examined the context for the conference interest in teachers' learning (See Appendix A for a list of conference presenters). Teachers are the indispensable link, she suggested, between the individual learner on the one hand, and the educational environment on the other. The latter includes the culture's expectations for schooling, educational policies set at all levels, and the school's organizational climate. Graham lamented a tendency within this environment to address the learning needs and problems of children as if these were somehow disjoined from issues of classroom dynamics and the conditions of teachers' work. She argued that schools must find ways to support resourceful teachers as the bridge between the characteristics of the child and the demands of the curriculum.

The conference's morning session, entitled "The Teacher as an Adult Learner," featured an address by David Hawkins with commentary by Henry Olds, Frank Sopper, David Olney, and Yolanda Rodriguez. Hawkins and these commentators examined parallels between children as learners and teachers as learners: both construct new knowledge by noticing and analyzing experience, by filtering this experience through an interpretive network of previously learned concepts, and by readjusting this network in light of the new knowledge. To learn in this way, the speakers noted, requires intensive engagement with phenomena, sufficient time for reflection, encouragement to risk new thinking, and

support from an experienced teacher who can point out discrepancies, pose questions, and guide the learner's thinking by means of a sense of a discipline's core structure.

All of these, the speakers added, are likely to be scarce, however, in the working life of teachers today. This scarcity is due in part to constraints on teachers' time, restrictions on their opportunities to interact with each other, and the sheer number of demands on their physical and intellectual energy(3). A view of teachers as learners seems simply incompatible with assumptions underlying many school policies and standard operating procedures. Most schools view knowledge as a relatively inert body of facts and concepts, teaching as the process of parceling it out, and learning as the process of receiving the parcels. The conference's afternoon session examined the effects of these views on teachers' opportunities to learn, and offered practical insight into how teachers and administrators might counteract them. This part of the program, entitled "Providing the Setting to Support Teachers' Learning," featured presentations by a panel of educators from two different school systems, including teachers whose use of computers in their classrooms had spurred their own learning and administrators whose support provided the critical context for this learning.

First, Richard Houde, chair of the Weston High School mathematics department, was joined by Gus Sayer, Assistant Superintendent of this small wealthy suburban school system. Houde talked about his collaboration with the developers of a piece of software called the Geometric Supposer, which is designed to provide a microcomputer

environment within which students may learn geometry and inductive reasoning by making and testing hypotheses(4). Next, Richard Horner and George Perry, both veteran mathematics teachers in the Boston Public Schools, spoke of their experiments in teaching with a computer. They were joined in their presentation by Ann Grady of the system's computer education department. Grady had organized a study to assess the benefits of using new technologies to teach math topics long considered difficult to teach, and as part of this study, had provided these teachers with special training and consultation. The afternoon session also included commentary by Joseph Featherstone and Judah L. Schwartz.

All the afternoon panelists probed issues related to the nurturance and protection of teachers' learning opportunities as a means of fostering school change. In the process, they spoke not only of supporting teachers' initiatives, but also of overcoming teachers' reluctance and resistance.

## CONFERENCE THEMES

Although every conference speaker and commentator addressed a particular aspect of the main conference topic, many of their comments also overlapped and interconnected in interesting ways. Several ideas that emerged early in the day, for example, were developed in more depth later. Thus this conference report will not summarize sessions -- beyond the brief summaries offered above -- but will instead present themes that cut across them. These themes are grouped below under two large headings: Opportunities to Learn, and Conditions for Learning.

### Opportunities to Learn

Before proceeding with this list of opportunities, it is important to note that the presenters and other participants in this conference sometimes used the word computer as shorthand for a fortuitous complex of circumstances, including not just the mere availability of a machine, but imaginative software to animate it, and an organizational context to support its creative use. All the numbered theme sentences which follow use the word computer in this same sense, or perhaps it is more accurate to say that their conditional language is meant to point to the conditions which can make a computer more than a dumb machine.

1. Computers May Provide Teachers Opportunities to Grow Through Pioneering and Tinkering.

John Dewey explained that liveliness in teaching demands constant growth in the teacher, and that this in turn depends on the teacher's continual ability to find new challenges within her subject(5).

Seymour Sarason suggests that teachers must find ways to cope with the draining routines of their daily work. In order to sustain their giving they must experience some measure of getting. Experimentation can be a crucial source of getting (6).

Many of the teachers who spoke at the conference identified the opportunity to be a pioneer as a principal incentive for their earliest efforts to integrate computers into their teaching. For example, the risk and excitement of trying something entirely new attracted Boston teacher George Perry to computers. And Cambridge middle school teacher Yolanda Rodriguez spoke of receiving a "stimulating shot in the arm." She explained that handling new challenges reassures teachers that they are growing professionally, improving their skills, and satisfying a basic need to keep moving in new directions. Thus technology can be a wellspring for teacher learning simply in its implicit offer of a new frontier.

And it can aid teacher learning as a tool for those who inveterately tinker with their teaching. That is how Richard Houde explained his attraction to the Geometric Supposer. His effort to integrate this software into his geometry course was initially a tinkering move -- like former moves to rewrite his textbook or design activity-based lessons. It was in this sense a step in a career-long effort to avoid stagnation in his teaching.

2. Computers May Prompt Some Teachers to Become Fresh Learners of Their own Subjects.

In his Conference address, David Hawkins spoke fondly of the power

within the science classroom of such primitive technology as the loom. It has dual powers, he said: it conveys information by virtue of its own dynamic presence -- a picture, for example, of how weaving happens; and it also frequently provokes students to inquire about its origins, its uses, and its effects on people's lives. Of course, the microcomputer is not primitive technology, yet many speakers and other panelists maintained that it can, under certain conditions, have similar powers, and that these powers may stimulate teachers' learning just as much as they do students'. Certain software in certain classroom contexts may convey a dynamic picture of an element within a discipline, as in the simulation of a science experiment, for example. It may simultaneously and deliberately prompt its users, including students and teacher, to think and talk about other elements -- factors perhaps left out of the simulation.

Yet panelists acknowledged that unanticipated classroom inquiry on the part of either students or teacher can present problems to the teacher, particularly in the context of schools as we know them. Richard Houde expressed the resulting paradox aptly:

> With computers you have to deal with a lot more uncertainty. The curriculum is no longer sequential and linear. Ideas are popping out of the blue. And as a teacher, you have to decide: Do you encourage students to pursue these ideas? Do you discourage them? Where do you place the emphasis? Do you tell the students, "OK, we're going to wait two months and then talk about it," or do you say, "We're going to talk about it now"?

Such uncertainty may prompt some teachers to return to the security of the linear curriculum; but it is bound to prompt others, as it did Houde, to reconsider how they organize the subjects they teach. Teachers who choose this second route must delve freshly into the

network of related ideas that constitutes their subject. They must forego reliance on their own and others' past learning as laid out in texts and curricular sequences, and must become learners again, surveying their subject's territory as if with new eyes. They must recall, or learn for the first time if they never learned it before, "that an academic subject," in Willard Waller's words, "is really a live phase of human thought and not merely a set of facts and figures to be memorized by sophomores"(7).

Why do some teachers accept a prompt to reopen their learning in a subject, while others reject it? One difference -- perhaps an intractable one -- may involve the teachers' previous learning experiences and how these have affected their self-confidence; another may have to do with their tacit understandings of what knowledge and learning are; and still a third may have to do with constraints implicit in the work conditions of their respective schools.

3. The Computer May Provide Teachers an Opportunity to Learn about Learning.

Patricia Graham emphasized her view that school reform requires that teachers develop an "intensive understanding" of their subjects. Hawkins went even further, saying that teachers must not only understand, but must understand in a pedagogically reflective way; they must not only know their own way around a discipline, but must know the "conceptual barriers" likely to hinder others. Waller identified the study of students' learning as the second best way (next to fresh study of the subject itself) for teachers to stay earnest and enthusiastic in

their teaching(8). The computer may facilitate such study by putting teachers in situations where they can observe the many ways in which subject matter invites, frustrates, and delights learners. Ann Grady held that software which conceives of many possible routes to an answer, or many possible answers, may allow teachers to see "how a child's mind is operating."

Hawkins noted that the computer may afford the teacher an opportunity to approach more precisely "the matrix within which the child already knows something." Hawkins has referred to this subtle, but in his view, essential dimension of teaching as "reading the students" and mapping their minds(9). This kind of student-watching and this effort to base one's teaching on it was part of what Richard Houde had in mind when he concluded that the Geometric Supposer is suited to teachers who like to "run with student ideas."

4. Computers May Prompt Some Teachers to Revise their Teaching Style.

Computers can change the context in which students and teachers work together in any subject -- including classroom routines, classroom organization, the use of class time and classroom space, and the mode of interaction between teachers and students. Richard Horner described himself as "the traditional stand in front of the class and line up the rows and I'm going to talk to you for forty minutes kind of teacher." After he had grouped his students to work as teams at computers, however, this pattern changed. With the focus off him at the front of the class, Horner found himself "getting around" to individual students instead. He was pleased, he reported, to discover the teaching

benefits of "doing a lot more individual things."

David Olney held that computer technology is "softening the barriers between what the student and the teacher tend to do." It has been his experience, he reported, that computers encourage collaboration and promote an easier, more natural exchange between teachers and students. Yolanda Rodriguez believes computers make it more acceptable for teachers to participate in inquiry along with children, alleviating some of the pressure to have a ready answer for any question their students might ask. If the computer can suggest to teachers that they are, at some deeper level of experience, learners of subject matter precisely as their students are, then the computer is indeed powerful. Seymour Sarason has suggested that one of the pernicious regularities of schools, which has continually stymied reform efforts, is the tendency among teachers to have two theories of learning and of thinking: "one that applies to them and one that applies to children"(10). The potential power of the computer to abolish this duality may be a function of its capacity to portray subject matter in a dynamic rather than a static way, and to thrust it straight into the heart of teaching. Thus teaching can become what it should be, according to David Hawkins' classic formulation: a three-term relationship rather than a two-term one, with an _it_ as well as an _I_ and _thou_ (11).

Richard Houde spelled out the implication of this change: the teacher's thinking becomes discernible and thus he models thinking for students. Houde is delighted to have become, as a result of teaching with the _Geometric Supposer_, "a working mathematician" with whom his

students can identify. Marvin Lazerson and the authors of An Education of Value point out that, in fact, teachers in all circumstances model thinking whether they wish to or not; what distinguishes the thinking that Houde now models, is that it is open and dynamic, rather than canned and dull(12).

Still, the effects of the computer on classroom routines and interactive norms may not all be positive. For example, panelist Frank Sopper, a third-grade teacher at Cambridge's Buckingham, Browne and Nichols School, worried that these effects may inhibit a critical dimension of the teacher-student relationship. Sometimes teachers must try again and again to get a learner started; they must search for the right moment, circumstances, words -- the right spark. He jokingly compared the process to the work of starting his old lawn mower which always demanded many tugs on its ignition cord; and which, even after starting, needed much tending to prevent stalling. Sopper's concern is that the computer's unsettling effects on classroom dynamics may interfere with the teacher's starting and tending; in the computer classroom, he said, "it's so easy for the student to come up with a question that stalls the relationship -- either because I don't have an answer, or because I feel threatened by the question."

One way to understand Sopper's concern is by the light of what several scholars of teaching have to tell us about the enormous complexity of the classroom experience. Ann and Harold Berlak, for example, describe the teaching act as a tremendously complex, simultaneous resolution of multiple dilemmas, an act of intense coordination and negotiati- (13). Magdalene Lampert overlays their

conception with an image of what she regards as the teacher's critical need to avoid stark choices in managing this myriad of dilemmas(14). Given work to do as difficult and refractory as these images of teaching suggest that it is, there is little wonder that Sopper might be concerned about unsettling influences.

5. Computers May Prompt Teachers and Others to Engage in a Critical Examination of the Deep Regularities of Schooling.

Seymour Sarason, Theodore Sizer, and David Seeley, among other constructive critics of schooling in America, have argued persuasively that schools will stay the same despite all efforts to reform, until those efforts root out some deep structural and cultural norms(15). In remarks that concluded this conference, Judah Schwartz suggested one scenario for how computers might abet such rooting out. He began by pointing out a recurring complaint of the day's presentations: the "tyranny" of school conditions makes innovation difficult. Many at the conference, for example, had lamented the inflexibility of time as schools apportion it and the rigid expectations that often mark schools' attitudes toward curriculum and students' movement through it. These, they had argued, are severe impediments to the innovative use of computers in teaching. But Schwartz stood this argument on its head: deep and pernicious regularities in the culture of schooling may perhaps have to be seen as impediments in order to be seen at all. One power of the computer in the hands of thoughtful teachers may lie in its suggestiveness that good learning might happen BUT for such impediments. Yet <u>seeing</u> such regularities is obviously not enough; they

must be changed too. Schwartz and Patricia Graham urged teachers to become activists, to push hard on school boards to abandon equivocal rhetoric about goals and think hard about what schools can be. But Joseph Featherstone offered fair warning that if they choose to enter the policy debate, they will find it dominated by those who would force a narrow definition of teaching purpose, one unconcerned with "what changes lives, what illuminates a mind," and one uncomplicated by an appreciation of the complexity of teaching.

Richard Horner told the story of how his efforts to use computers in his teaching became the occasion for a run-in with a regularity. While piloting some math software he found himself suddenly at odds with the specifications of his school system's master curriculum. Although the particular software he used covered elements this curriculum plan requires -- like the metric system, graphing, and problem solving -- it tended also to engage his students in deeper and longer study than strict adherence to the plan could accomodate. To follow such learning lures is to leave less time for studying other topics. In his case, Horner clearly thought the net gain in his students' learning worth the cost, but he was acutely aware of the political dilemma attached to his calculation. How, he asked, can a teacher in a system like his, which judges students' mastery by means of centrally written curriculum-based tests, credibly explain to parents that their children are learning more though their scores may have dropped?

Richard Houde alluded to the same dilemma when he spoke of his efforts to ensure that his students' work with the Geometric Supposer

did not preclude coverage of any geometric material likely to surface on the Scholastic Aptitude Test. In the process, however, he hinted that the tension -- if well managed by the teacher -- may also have its beneficial effects:

> Another thing that happens is I have to pull them away from their work when I think they need to move on. All right, David Hawkins said this morning it's not whether you cover the course; it's whether you uncover it. I agree with that; that's true. Unfortunately I cannot, I feel, as a teacher, put my kids at risk. The SAT and achievement-test system in this country still dictates what kids have to know about geometry, and until that changes, I feel I must teach a geometry course that covers material that they need for that particular test. So I've tried to combine a little bit of both of them. In fact, it's a little bit scary to me. . . What would happen to schools if Princeton, N.J. were not in existence? What would mathematics curriculums look like?

In response, Schwartz applauded such questions as these, and suggested that they illustrate his point: the computer can help to bring regularities into critical light. Once in the light, they can be viewed for what they really are -- active elements in schooling for good or ill; not neutral background factors.

## Conditions for Learning

Thus far this report has focused on the learning opportunities that technology may provide individual teachers. Even the casual reader may notice the conditional phrasing in the last sentence and in all the theme statements listed above. What are the conditions governing this <u>may provide</u>? The following set of themes attempts to answer this question.

1. Teachers Must Be Partners in Innovation.

A considerable body of literature suggests that so-called top-down reform is very likely to become failed reform, that the teacher who is treated as the mere tool of reform becomes instead its saboteur(16). Joseph Featherstone has written flatly that the indispensable growing medium for innovation -- the individual school's ethos -- is a joint creation of students and teachers and cannot be engineered by anyone else(17). An implicit recognition of this fact of school life laced the talk of this conference.

However, Yolanda Rodriguez, among others, noted that the teacher cannot achieve reform by herself, that wholly bottom-up reform is as hopeless as wholly top-down. While she expressed admiration for colleagues on the cutting edge -- "people who are leading the way and serving as role models that we would love to follow" -- she also pointed out at least two enormous handicaps of the lone teacher-reformer: scarcity of time, given the working conditions of teaching; and a sphere of influence that generally stops abruptly at the classroom's edge. To these two, Patricia Graham added a third -- the physical and psychic isolation of teachers from their colleagues.

So one conclusion reached at this conference is that if new educational technology is to be the catalyst for teacher growth and consequent school reform, then it must do its catalytic work within a partnership. The critical members of such a partnership are, of course, teachers and administrators. But others are important too: the students who are expected to benefit; their parents; other members of

the community; the computer industry; and — not least — the university. The basis for such a partnership, Richard Houde suggested, was a willingness among all the partners to focus on what the teacher really does and what he really needs. Houde is amused, he said, by descriptions of his work with the Geometric Supposer as "radical" experimentation. Regardless of how different his geometry class may now be as a result of the Supposer, the fact remains, he explained, that in his mind the software came along when he needed it to do the things that he wanted to do. The "radical" change that it brought felt to him like incremental change. That is not to say that all teachers in all situations can as readily perceive what they need and want as Houde was able to do. It is simply to say that the teacher must, and in fact will, be the final arbiter.

2. Teachers Need Time to Learn.

David Hawkins reminded conferees that any learning — even the learning of what may appear to some to be simple concepts — is an exceedingly complex undertaking. He recalled John Dewey's notion that a learner "reconstructs" subject matter, and in the process experiences as partial, inexact, and fluid, what is to the expert a whole, precise, and logically interrelated network of concepts(18). One important consequence of this complexity is the amount of time that it consumes.

All teachers know at least tacitly, and often in intimate and painful detail, how much time their students' learning requires. One theme of this conference was that teachers' own learning is no different in this regard. Just as students need time to reconstruct

subject matter, teachers need time to discover how classroom uses of technology can fit, enhance, or even transform their teaching. And they need time to absorb these discoveries and to adapt their practice accordingly.

Weston Assistant Superintendent Gus Sayer reported that his system had released Richard Houde from one-fifth of his teaching time so that he might have sufficient time to experiment thoroughly with the Geometric Supposer. Such commitment of time on the part of a school system is exceedingly uncommon, however, as Sayer acknowledged. That is because school budget requirements are commonly conceived not on the basis of teacher/student ratios but on the basis of teacher/class coverage. Such a conception makes even one-seventh of a high school teacher's work time (a one-period slice of the typical seven-period day) seem a precious commodity. But this valuation is ironically misleading because it is based on an inadequate understanding of how much more than "coverage" good teaching really is, and of how much it depends on teacher learning. Judith Warren Little's research has documented the connection between, on the one hand, an excessively high valuation of the teacher's time, and on the other hand, an inadequate degree of attention to the interactive opportunities that teachers need in order to learn. She writes, "In a work situation where time is a valued, coveted, even disputed form of currency, teachers can effectively discount any interaction by declaring it a 'waste of time'"(19).

The historical roots of the school's rigid approach to time, according to Joseph Featherstone, are in American schooling's

late-nineteeth-century liaison with "bureaucratic and managerial models." Among those who tell the story of this liaison are Raymond Callahan and David B. Tyack(20). The persistence of the liaison today, according to Featherstone, explains much about the tendency of current reformers to search for change levers outside the school itself, and to opt for such change strategies as those which, like centralized curriculum planning, entrust practitioners with less rather than more control. If computer technology succeeds in changing schools, in Featherstone's view, it will be because it changes the locus of control.

3. Teachers Need Collegial Advisors.

David Hawkins reminded the conferees that learners frequently require the assistance of teachers, and that this remains the case even when the learners are themselves teachers. The two projects that provided the focus for the afternoon session of this conference -- the Boston project described by Richard Horner, George Perry, and Ann Grady; and the Weston project described by Richard Houde and Gus Sayer -- both relied to some extent on expert advice. In the case of the Boston project, this advice came from central office personnel; in Weston, it came particularly from one of the co-authors of the Geometric Supposer, Michal Yerushalmy. David Hawkins observed that the role that these consultants played in the development of both projects was akin to that played by emissaries of the Ministry of Education to local schools in Great Britain:

> The role which we came to call advisor, rather than supervisor, is that of a person who is well qualified as a

> teacher, who understands the problems and knows the smell of the classroom. This individual has to know about many things -- like organization and difficult children -- and also be enthusiastic about finding and trying out new ways of getting into subject matter.

Houde depicted the complexity involved in such a relationship, and suggested that it is characterized by the same conflict in the interest of growth that marks all good teaching:

> She [Yerushalmy] has been my lifeline. She is the person who comes in once every week or two and wants to know how I'm doing and if I need any ideas and she's also the person who comes in and yells at me if she thinks I should be trying something that I'm not, and I think that's been a very, very key ingredient in what I've done the past two years. Without her, I don't know if I would still be doing what I'm doing this year. I mean, I'm doing more than I had intended this year and I think it's because of her.

As all learners must to some extent entrust themselves to their teachers, Houde entrusted himself to Yerushalmy -- even endured her "yells". He did so, of course, to honor the implicit contract at the heart of their relationship, which specified, among other things, that the aim of all her criticism was his growth. It is the same contract that his own students honor when they endure his criticisms, his grading of their efforts. The difference is that he and his students thereby follow a powerful social norm, while he and Yerushalmy did not. Judith Warren Little, in a recent study of a peer advisor program for teachers, found the program hampered by the absence of norms to support it. There is, she states, simply no established tradition in the teaching profession by which teachers receive advice on their teaching (as opposed to supervision) -- from <u>anyone</u>, including peers. There are no strategies known to be dependable, no etiquette to follow, no rules of thumb to help distinguish between advising and leading(21).

It is important to note here, however, that "advising" in the two cases reported at this conference involved more than giving advice; it also meant helping out. The advisors made it their business to alleviate the inevitable added burdens of innovative teaching, by helping, for example, with the preparation of new work sheets and problem sets, and by serving as a second roving classroom coach.

Moreover, both advisors took a researcher's interest in the work of the teachers they advised. The teachers thereby gained a rationale for engaging in reflective practice that went beyond self-improvement. Houde knew that his work was contributing directly to the improvement of a product -- namely the software itself, then under development -- and that many other teachers would eventually use this product. Similarly, Horner and Perry knew that what they might discover about teaching math topics with computers could affect how teachers teach these topics throughout the Boston school system. In a sense, the advisors in these cases illustrated by their very presence the power of the teacher's voice in achieving school reform. They were present not to mold a teacher's behavior, but to facilitate a teacher's growth so that this growth might become a model for the growth of others.

## CONCLUSION

This conference confirmed that teaching with new technologies can create powerful opportunities for teachers to become eager students. That is because the introduction of the computer into classroom teaching, under some conditions — including especially the quality of the software, and the receptivity of the teacher — jars the status quo in such a way as to provoke a reexamination of teaching's regularities. Software like the Geometric Supposer which invites users to create knowledge can provide an occasion for teachers to take a new interest in their subject. At the same time, it can cast fresh light on learning and stimulate teachers to take a new interest in the learning process. Finally, by implicitly challenging prevailing assumptions about curriculum and instruction, it can entice teachers to think critically about the purposes and procedures of school.

But, the conference suggested, none of this new learning is likely to lead to meaningful school change if it lacks a supportive organizational context. Teacher learning can be powerful only if the teacher is powerful, that is, only if she is treated as innovation's partner, not its tool. And teacher learning can achieve its full flower only if teachers have time to let it grow. Finally, teacher learning can progress beyond the simplest level of novelty interest only if teachers can find alternatives to the norm of classroom isolation.

NOTES

1) Among the notable exponents of this view are Michael Lipsky in Street-Level Bureaucracy: Dilemmas of the Individual in Public Services (New York: Russell Sage Foundation, 1980); Seymour Sarason in The Culture of the School and the Problem of Change (Boston: Allyn and Bacon, 1971); John Goodlad in A Place Called School: Promises for the Future (New York: McGraw-Hill, 1983); and Theodore R. Sizer in Horace's Compromise: The Dilemma of the American High School (Boston: Houghton Mifflin, 1984); also three of this conference's presenters: Patricia Albjerg Graham, in "Schools: Cacaphony About Practice, Silence About Purpose," Daedalus, 113, No. 4 (1984), 29-57; David Hawkins, in "Nature Closely Observed," Daedalus, 112, No. 2 (1983), 65-89; and Joseph Featherstone in "Change Thy Ways: Reflections on the Reform Movement in Education," The Boston Phoenix, 14 August 1984.

2) See "The Computer as a Teaching Tool: Promising Practices," Conference Report of the Educational Technology Center, Harvard University, Cambridge, April 1985.

3) Among those who have argued that typical working conditions have injurious effects on teachers' capacity to function with full intellectual vigor is Dan C. Lortie in his Schoolteacher: A Sociological Study (Chicago: University of Chicago Press, 1975). Significant recent examinations of this issue can also be found in Sizer, Horace's Compromise; and Ann Lieberman and Lynne Miller, Teachers, Their World, and Their Work: Implications for School Improvement (Alexandria, VA: ASCD, 1984).

4) The Geometric Supposer (Pleasantville, N.Y.: Sunburst Communications, 1985).

5) John Dewey in Experience and Education (New York: Macmillan, 1938), and other works.

6) Sarason, The Culture of the School, pp. 167 - 168.

7) Willard Waller, The Sociology of Teaching (New York: Wiley and Sons 1932), p. 226.

8) Waller, Ibid.

9) David Hawkins, "What It Means to Teach," in The Informed Vision: Essays on Learning and Human Nature (New York: Agathon, 1974).

10) Sarason, The Culture of the School, p. 182.

11) David Hawkins, "I, Thou, and It," in The Informed Vision.

12) Marvin Lazerson, Judith Block McLaughlin, Bruce McPherson, and Stephen K. Bailey, An Education of Value (New York: Cambridge University Press, 1985), p. 103.

13) Ann and Harold Berlak, Dilemmas of Schooling: Teaching and Social Change (New York: Methuen, 1981).

14) Magdalene Lampert, "How Teachers Manage to Teach," Harvard Educational Review, 55 (1985), 178 - 194.

15) Sarason, The Culture of the School; Sizer, Horace's Compromise; David S. Seeley, Education Through Partnership: Mediating Structures and Education (Cambridge: Ballinger, 1981).

16) Perhaps the most dramatic account of this dynamic is Harry F. Wolcott's in Teachers Vs. Technocrats: An Educational Innovation in Anthropological Perspective (Eugene, OR: Center for Educational Policy and Management, 1977).

## APPENDIX A

## TEACHER AS LEARNER: THE IMPACT OF TECHNOLOGY

### Participants

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Richard Horner
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17) Joseph Featherstone, "Change Thy Ways."

18) John Dewey, Democracy and Education (1916, rpt. New York: Free Press, 1966), pp. 182 - 184.

19) Judith Warren Little, "Norms of Collegiality and Experimentation: Workplace Conditions of School Success," American Educational Research Journal, 19 (1982), 325 - 340.

20) Raymond Callahan, Education and the Cult of Efficiency (Chicago: University of Chicago Press, 1962); David B. Tyack, The One Best System: A History of American Urban Education (Cambridge: Harvard University Press, 1974).

21) Judith Warren Little, "Teachers as Teacher Advisors: The Delicacy of Collegial Leadership," Educational Leadership, 43, No. 3 (1985), p. 36.