TECHNOS Quarterly

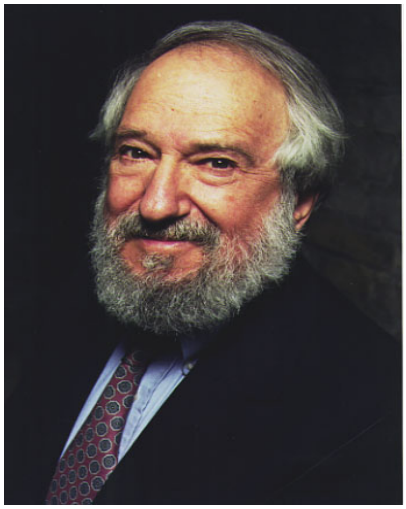
For Education and Technology

Vol. 7, No. 4, Winter 1998

Let's Tie the Digital Knot

By Seymour Papert

A mathematician, an early pioneer of artificial intelligence, and an internationally recognized seminal thinker about how computers can change learning, Seymour Papert worked with educational psychologist Jean Piaget at the University of Geneva from 1959 to 1963, a collaboration that led Papert to consider using mathematics in the service of understanding how children think and learn. As more and more students gain access to computers and the Internet, Papert offers his prescriptions for consummating the marriage of education and digitalism. He sees most present uses of computers in schools as mere flirtation.



In a closing speech to the Sixth World Congress on Computers and Education in 1990 I asked a question that I still see as the central challenge to the community represented there: When will we stop holding conferences whose very titles define us into a subservient position?

The others, the traditionalists, wouldn't dream of giving their field of interest a name like “Paper and Education.” They simply call it “Education,” thereby expressing their perception of themselves as owning the terrain, which they admittedly do—for the moment. But, with a touch of fantasy, I can imagine an inversion of this situation in a future scenario where educational antiquarians use names like “World Congress on Paper-Based Education” and “The Journal of Computer-Free Schooling.” Those who attend meetings with names like “World Congress on Education” will be our kind. Like the readers of TECHNOS, they will be technologically fluent people who have absorbed computational ideas into their culture and want to see deeper changes in learning than the others even imagine.

Playing with names is symbolic of something much deeper. The WCCE's subservient title appropriately described a subservient content. In session after session at its meeting and in article after article in journals, ingenious, dedicated, sometimes brilliant educators vie with one another to make the most powerful technology ever invented serve modest educational goals adopted at a time when primitive predigital knowledge technology permitted nothing but modest goals.

In my trademark caricature of this situation, a nineteenth-century transportation engineer invents a jet engine and attaches it to a stagecoach to assist the horses. But the transformative contribution of the jet engine to transportation did not come from improving already existing vehicles. It came through the invention of a radically new kind of vehicle—the jet plane.

My WCCE question was a call to attendees to redefine their roles from server of education-as-it-was to inventor of education-as-it-will-be. Here I want to repeat this call and prescribe three remedies to help cure inhibitions that prevent some people from heeding it. My Rx includes more chutzpah, paradigmatic vision, and plain language.

More Chutzpah

It takes intellectual chutzpah to be serious about replacing "using technology to improve education" by a similar sounding statement with a very different meaning: "inventing new visions of education in the context of a digital world." And it takes personal chutzpah to face down members of the Education Establishment when they sneer (or worse, smile) at the idea of technology significantly influencing the content of education. "It is just a tool," they say; "technology should serve the curriculum, not dictate it."

It is lack of chutzpah that prevents many of our colleagues from looking the would-be humanist in the eye and saying: "No, Doctor Professor, the boot is on the other foot. It is your established curriculum and your concept of School that were dictated by technology—the pre-twentieth century technology of writing, printing, and calculating. The real offer of digital technology is liberation from the consequences of having been restricted by these primitive tools!"

But more than chutzpah is needed. Most workers in the field of educational technology might be hard put to defend this turning of tables, and that has two consequences, both of them bad for the development of a strong movement. First, its advocates do not come off well in debate with its critics. Second, and more important, people in the field are discouraged from setting themselves big goals and settle for making incremental improvements.

So besides chutzpah we need the ability to develop big visions to support it. My prescription for doing that better is simply to spend time doing it—the muscles of the mind will grow through exercise.

Paradigmatic Vision

Using an Internet connection in the classroom to enliven the fourth grade math curriculum is a good thing. By all means do it if you are a fourth grade teacher. But do not confuse it with the

prescribed activity of developing a vision of the future of learning.

As an exercise of the educational imagination to strengthen your visionary powers, think about a world in which there is:

- No such thing as fourth grade, because age segregation has gone the way of other arbitrary divisions of people.
- No such thing as a classroom, because learning happens in a variety of settings.
- And no such thing as curriculum, because the idea that everyone should have the same knowledge has come to be seen as totalitarian.

Your assignment in this exercise is to figure out whether such a world could work. Be clear. I am not proposing this as an education reform. You are probably already skeptical about education reforms, and if you want your skepticism reinforced, look at my reading list. Nor am I pushing it here as a prediction of what's coming—though I'd take a side bet that the future will be more like the one pictured in this exercise than like most present-day learning environments. I am doing something different in kind from proposing or predicting: I am suggesting that seriously developing and seriously confronting alternative scenarios be recognized as a valuable kind of work—work needed to facilitate the emergence of the future.

My problem here is how to give, in a few paragraphs, an idea of what I mean by “serious” without getting into really serious content discussion. But I'll do my best by sketching a few features of a vision of mathematical activity for children that has emerged from my own work over the past 30 years.

The key feature is breaking away from a paradigm in which the “mathematical act” is manipulating a mark on paper. Doing that is a much bigger step than the steps taken by the new math of the 1960s or the softer new math now proposed by the NCTM. Manipulating pencil-on-paper symbols for sets instead of symbols for numbers is still manipulating marks on paper; it does not break out of the paradigm. Nor does using the manipulations to solve ill-defined problems. Nor, indeed, does transposing the symbols to an electronic screen.

In my alternative paradigm the primary mathematical act is manipulating a dynamically active computational object. Typed text might be used, but the fact that a mouse click or a voice command can have the same effect brings out clearly that mathematics is not about marks on paper. Here text is on tap, not on top.

Carrying this idea into implementable form has required hard work (really hard work!) on the representation of mathematical entities. For example, what a mathematician would call a random variable takes the form of a computational object that can be fed another object that the mathematician would call a probability distribution, then connected to yet another object that produces colors or shapes or movements. For a student working in this way it is possible that from the beginning mathematics is connected to making things happen, as it was in the historical origins of mathematical science. Mathematical ideas such as randomness can be experienced as powerful because they can be used powerfully for effects that are interesting to

an eight-year-old child.

I know that this description will evoke a cloud of objections. Educational psychologists will protest that young children cannot understand such things as random variables and probability. Curriculum designers and high priests of the Ancient Knowledge Sanctified in International Tests will warn us that such things have no place in the curriculum. Some mathematicians will say that in these computational forms the concepts are not real mathematics. Some teachers will complain that this kind of work makes their job impossibly difficult.

I have become quite expert at giving brief answers to each kind of protest. But here is my point about being serious: I won't do it because brief answers to big questions are exactly what is not needed. The field is suffering from far too much of that. What is needed is to mobilize an intellectual community to give to this kind of problem the level of attention and resources currently reserved for efforts to bolster a traditional curriculum that is in any case condemned by history.

I cannot make this last point too strongly: I believe that the major reason for the slow response of the education world to the possibilities opened by new technology is the failure of our community to assume intellectual responsibility for long and full discussion of such questions. More inhibiting than the lack of technology or funding or brain research or anything like that is a lack of serious, controversy-rich, conceptual discussion about difficult issues such as the epistemological foundations of knowledge (for example, what is mathematics?), the nature of learning (how active must learning be to count as active learning?), and the sociopolitics of our own movement (what I am about to discuss in the next section).

Plain Language

Public debate about computers and learning is mired in confusions that are greatly aggravated because these weaknesses in our internal intellectual culture inhibit us from working more energetically and effectively for public clarity. An illustrative example is seen in some responses to a scurrilous attack on the use of computers in education that appeared in the July 1997 *Atlantic Monthly* (accessible at *www.MilkenExchange.com*).

Without exception the hundred or so people with whom I discussed the main story, which was written by Todd Oppenheimer, interpreted it as evidence that computers don't improve learning. Even Editor Mardell Raney, in interviewing Lewis J. Perelman in TECHNOS (6:3, Fall 1997) stated that the article made the case that "multimedia, distance learning, and all that really are no better for education than the traditional classroom." That is clearly what the editors of the *Atlantic* (and perhaps the author) wanted us to take from the article, and they set it up so we would.

But if you take a lawyerly look at the article's opening assertion you see that Oppenheimer —deliberately or by luck—covered himself by making a much weaker statement: "there is no evidence that most uses of computers [in schools] significantly improve learning or teaching." If he had used plain language and simply said that most schools use computers poorly, the response of most intelligent people would have been "So what else is new? Most schools use books badly and pianos badly and everything else badly." It might have been a scandal. But it

would have been a different scandal and would not have served the purposes of sensational journalism, which *Atlantic's* cover exploited to the full. As it is, the language of the debate constitutes intellectual pollution, not only because it leaves people muddled and confused about facts but especially because it encourages poor language usage and poor formulation of questions.

More intellectually serious people (see "Computers Make Kids Smarter—Right?" by Larry Cuban and Heather Kirkpatrick in TECHNOS 7:2, Summer 1998) contribute to the same pollution by continuing to describe the object of their study as the question "Do computers improve learning?" What is that supposed to mean? The way most people read it, the question calls for a hard response: "It's not the computers, silly, it's what you do with them!" Of course it is absurd to say that Cuban and Kirkpatrick are silly: they know that what they mean is a kind of statistical statement about schools as a whole population. But does the public know that? I think we ought to jump on these authors for using language that encourages people to ask the wrong questions.

Such confusions are not easy to neutralize, especially since powerful forces have an interest in the kind of confusion that breeds them. I suspect deliberate verbal and political trickery when the White House states that something called "equity" will be achieved ensuring that every child "has access" to the Internet. That's like promoting financial "equity" by saying every child will "have access" to money and then giving each one a dollar. You'd think the point was obvious: "having access" and "using computers" are not yes-or-no conditions; they come in degrees and forms, they exist in contexts, they are used by people who have vested interests in the perpetuation of certain institutions or professional qualifications or ways of thinking. Yet the band plays on.

So what can we do? Exercise chutzpah in boldly thinking up alternative visions. Exercise chutzpah in not allowing anyone to get away with loose talk. Ask embarrassing questions: "You say it's important for American children to have equity in access to computers and the Web? So why don't you give each of them a personal computer? Isn't that what equity means?" "This kid has learning disorders? How come he beats you at that game he didn't get until last week? Learning games is different from math learning? How do you know it has to be different?"

Kid Power

Some final questions, and these are for me: How do you manage to be optimistic? Why do you think that education will change this time if it never did before? Why do you think that this technology is so transformative when many other vaunted technologies had little effect on School?

This time I will give a really short answer. I call the force Kid Power.

In this article I have been urging you—my colleagues—to action. Some of you will take up the challenge. Many have already done so. But the real army that will make the system change is filled with troops of kids. The ideas I have expressed will trickle down to these kids—or, more likely, be reinvented by them. Kids who have grown up with computers at home will be

less and less inclined to let parents or teachers get away with loose talk and backward ideas. They will be less and less willing to buy into a school system that offers learning that is inferior to what they can experience outside.

A hundred years ago John Dewey criticized school much as we do today. He had only a marginal effect because philosophical arguments have never budged an entrenched social system. At least not without an army. The kids will be the army for our cause.

Books by Seymour Papert

- *Mindstorms: Children, Computers and Powerful Ideas*. New York: Basic Books, 1980.
- *The Children's Machine: Rethinking School in the Age of the Computer*. New York: Basic Books, 1993.
- *The Connected Family: Bridging the Digital Generation Gap*. Atlanta: Longstreet Press, 1996.

Essays by Seymour Papert

- Exploration in the Space of Mathematics Education. *International Journal of Computers for Mathematics Learning* 1, pp 95-123. 1996.
- Why Education Reform Is Impossible. *Journal of Learning Sciences* 6:4. 1997.

Since the early 1960s, Seymour Papert has been at the Massachusetts Institute of Technology, where, with Marvin Minsky, he founded the Artificial Intelligence Laboratory and coauthored the seminal *Perceptrons* (1970). Papert is the inventory of the Logo computer language and, in 1985, was one of the founders of the Media Arts and Sciences Program and the MIT Media Laboratory. In 1988 he was named LEGO Professor of Learning Research, a chair created for him. Papert, who lives in Maine, can be contacted at *papert@ml.media.mit.edu*.

TECHNOS Articles Listed by : Author Title Issue Volume Indices
Subscribe E-Mail TECHNOS Staff Submit an Article