Decision Maker

Dr. Seymour Papert
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"Technology in education usually means inventing new gadgets to do the same old stuff. The only people who get any sense of intellectual adventure out of it are the people who invent the gadgets. By the time the kids get to use it, it's just boring."

Thus, Seymour Papert, holder of two doctoral degrees and professor of applied mathematics at the Massachusetts Institute of Technology, expresses the thinking that has guided some of the most radically innovative uses of computers in educational projects to date.

Papert, who was born 42 years ago in Pretoria, South Africa, has spent more than a decade studying the logical development of children. Between the years 1958 and 1963, he worked with noted zoologist-turned-child-psychologist Jean Piaget at the International Center for Genetic Epistomology in Geneva. In 1963, Papert came to MIT. Since then, he has been applying his knowledge of mathematics and computer techniques to attempt to develop the kind of educational system that children need, as opposed to the kind of educational system that they now have.

"The basic problem with education is that it takes such a long time to do such a trivial thing," he observes. "I believe that, with quite simple techniques, you can reduce the amount of time necessary and increase the average performance dramatically."

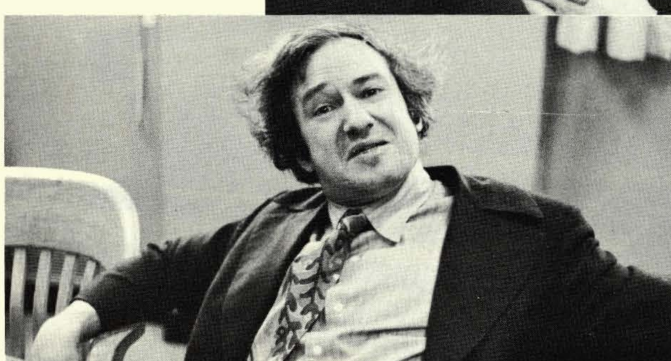
To prove his point, a little over a year ago Papert directed a project which involved giving 12 Lexington, Mass. seventh graders an opportunity to experience computer programming and computer power. The programming experiment was substituted for the students' regular mathematics course. Yet, at the end of the year, the programming students scored higher on standard mathematics tests than did the students who had taken the regular mathematics course. In the meantime, the experimental group had learned sophisticated mathematical concepts and had grown familiar with computer techniques.

Papert is uncompromisingly opposed to standard educational techniques which rely on memorization, drill-and-practice, and dictatorial teachers. He derisively labels these techniques the "pop-ed culture."

"By refusing to replace the pop-ed culture with something else, we're doing a lot of harm to the students — we're turning off their minds while they're young. Drill and practice usually means drill in elementary, local facts and skills — it ignores the problem of giving the child the means to organize his thinking. The real world just isn't made up of a series of clear-cut simplistic steps. Real problems are fuzzy, murky. You have to struggle to get some order in it. This

"Contemporary educational methods turn off kids' minds."

"Usually, technology in education means new gadgets doing old stuff."



"Some of my best friends are drill-and-pactice people."

"There are many things in the world that are both fun and educational."

process of passing from global disorder to building up a clear picture of the problem is the essence of what the kids should be learning. Breaking things into little drill steps and guiding the kid through deprives him of the experience of organizing it for himself. This is dangerous."

Despite his opposition to their more regimented approach, Papert respects the efforts of those people like Patrick Suppes of Stanford University who are using computers to automate drill-and practice techniques. "Some of my best friends are drill and practice people," he quips, "Those who aren't trying to fool anyone — who admit that they're automating drill-and-practice and don't pretend to be anything else. However, with proper teaching techniques, I don't believe that drill and practice should be necessary, and if it is considered necessary, then the students should be allowed to program it themselves. Indeed, why deprive them of that exercise? It's a very beautiful experience."

Papert's idea of what proper teaching techniques consist of involves a stimulating, flexible environment. He has found that computers are an ideal medium for creating such an environment. "One of the benefits of a computer is that the variety of things you can do with it is so great. With computers, there is a substantially bigger chance that you can lead the child with less effort into something that he really likes doing. I think there are things in the world that are fun — for everybody there is something that is fun. The intersection of the set of fun things with the set of educational things is sufficiently big so that you should be able to keep every student internally motivated."

As an example of his "fun-ed" approach, Papert cites the case of a girl student in the Lexington experiment who was doing poorly in all parts of school. She liked only two things — horses and dancing. "If she got the slightest opportunity," he notes "she'd go off quietly to the corner blackboard and either do a few dance steps or get into some intricate position and draw a horse on the blackboard." The girl was wholly indifferent to the computer terminal until, toward the end of the year, the whole class was shown how to write picture-drawing programs. "The girl was determined to draw a horse. For the first time in the whole year she fought for terminal time and was excited about learning," Papert recalls.

As a result, she not only learned programming techniques, but also needed to understand such mathematical concepts as co-ordinate transformation in order to get the right spacing for her drawing. "There isn't anything that some child can't be gotten interested in," Papert asserts. "There are really only two effective ways of getting a child to concentrate on something: you can beat him if he doesn't, or you can give him something that he likes to do."

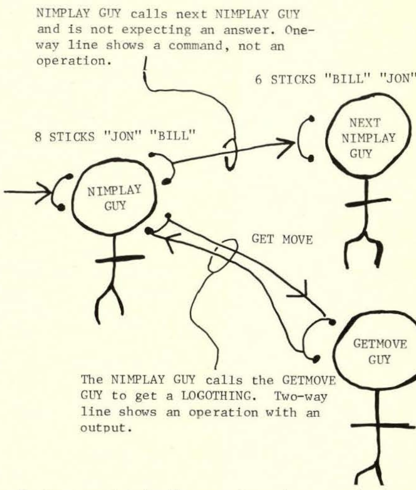
His style of "learning as much from children as we teach them" is reflected in the way Papert expresses himself. His words come through a flurry of hands and hair, and he sits not in his chair, but all over it. In the middle of one animated discussion Papert stopped short, stared at the photographer, and observed, "That's a scary looking camera you've got there."

"You've got to begin with a sensitive understanding both of children's conceptual deficiencies and of their abilities." For example, the children in the experiment had trouble learning to give names to things and be consistent about it — obviously an important part of programming. They also had been taught the very bad habit of throwing away incorrect solutions. The programming experience taught them to search for "bugs" and learn by correcting them. Common errors such as the "Inconsistent Name Bug" and the "Slip-By Bug" (resulting from an incomplete stop test) were identified and understood. Through programming, the children were found to have a startling ability to assimilate numerous mathematical concepts. For instance, their first lesson in programming involved an endless loop which introduced the concept of recursion.

Very little "teaching" was done in the experiment — it was found that very few programming operations were needed to enable the students to write exciting programs. Emphasis was on immediate pay-off. It was also found that giving the children models to copy is much more effective than verbal explanation — the students learn from making variations on the models.

"One of our important problems is finding decent teachers," Papert notes. "We tried a regular teacher, but her training made her try to get the students to understand everything before they went on to the next thing. She was overcontrolling the kids, explaining everything, and spoiling their sense of discovery." Papert prefers to "give the kids a couple commands and set them free on the terminals."

This is a flow chart?



In the experiment with seventh-graders, standard flow charting was found to be too general and rigid. Program functions were therefore represented as "little men" exchanging commands and intermediate answers over telephone lines.

"Kids should see technology as an enriching, creative thing."

photos by Laska

The purpose of the teacher in this system is to keep the students challenged and stimulated, on the one hand, but to avoid frustrating them with problems too far beyond their capabilities, on the other hand. "The gap between what the kids can do and what they try to do should be reasonably small," Papert advises. He compares the teacher's role in such a system with that of a governor on a steam engine — to make the minor adjustments necessary to keep the system running smoothly.

But would he put everything on the computer? "That's like asking if I'd put everything on to a pencil — computers are just a means to an end, they're like super-technological pencils. They should be available to you for whatever subject you want to teach."

Because he places great stress on the flexibility of his computerized educational methods, Papert is strongly critical of IBM's Coursewriter program. "IBM has done a lot of harm, I think, by putting out that Coursewriter for programmed instruction. It's so terribly cramped and rigid. As a result, a lot of people who might have done better things are producing very bad stuff because they've been forced to work inside the Coursewriter system. You can't do anything except pre-programmed junk inside it."

As far as finding the talent needed to run his programs, Papert asserts that, "Teachers don't have to be so dumb. Education has become a low-grade intellectual area — graduate schools of education tend to be the lowest level of university departments and the worst people go into them. However, I detect a movement of bright young people who are interested in improving education. It's part of a social movement that has about it a feeling of rightness and social relevance."

For his part, Papert hopes to establish an "Intelligence Institute" where a nucleus of bright graduate students can perform radical experiments in teaching children. "We would offer the opportunity of discussions with educational philosophers about the structure of concepts, and with psychologists about how the mind works. Due to improved technology, a substantial number of educational breakthroughs are now, for the first time, possible. These people, with their understanding of the mind and of computers, could help make our educational system whole orders of magnitude better." □

Interview by Richard M. Laska