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Teaching Teachers, Teaching Students

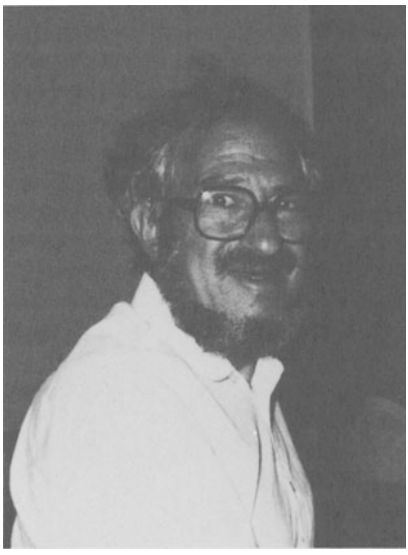
Reflections on Mathematical Education

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Seymour Papert

"We are at the beginning of what is the decade of mathematics education. I think the 1980's are going to be a turning point in the development of mathematics education on all sorts of levels. We will see dramatic changes in what children learn; we will see subject matters that formerly seemed inaccessible or difficult even at college level learned by young children; we will see changes in where learning takes place, and in the process of learning itself. Above all, we will see integration of mathematics into the whole person, with an emphasis on aesthetics, on feelings, on emotions, and on culture in a way that has not been part of our society for a long time. The challenge to the community of mathematics educators is fantastic.

"Back in the 1960's we mathematicians and mathematics educators decided to impose something that we thought was for the good of the people and for the good of the children. We decided, for various reasons, that it would be good for children to know set theory and logic, so we decided to pass these good things on to that culture out there. But it didn't take.



Seymour Papert

"I think the situation now is reversed. The world out there, for a first time in a long time, really wants something mathematical. There is a real change out there. If we can get ourselves together enough to listen to what is going on, I think that we can change the relationship of mathematics to culture. And that's what we have to do if we are to produce any radical change in the learning of mathematics."

So began the Congress's third plenary address, a vision of a not-so-distant future by Seymour Papert in which computer culture becomes a carrier for mathematical knowledge. Papert is a mathematician and psychologist at the Artificial Intelligence Laboratory of the Massachusetts Institute of Technology, where he directs project LOGO, an innovative NSF-supported attempt to develop a geometric language for computers that can be learned and manipulated by very young (pre-school) children.

Papert recounted his experience with a four-year-old named Robin who was playing computer games. One day, when her teacher came to give the computer the necessary instructions to change from one game to another, Robin said, "Let me do that." Robin's teacher was inspired enough to say OK, and wrote down on a piece of paper the necessary symbols.

"Robin couldn't type, couldn't read, couldn't write. But she began pecking away at the keyboard, copying these things she saw the teacher do. All of a sudden Robin found herself in a position where she was using alphabetic language. She was using that alphabet to make something happen, and I think in doing that she was showing us what might be a very important insight, a very important window onto the future.

"It is hard to say exactly what Robin was learning, but she was clearly learning something about the written language. And the question that this raises for me is very deep. Let's pose it like this: Why is it that children learn to speak the vocal language so early and the written language only after such a long delay? It is assumed by the educational system that this is a natural thing to be expected, but what are the reasons?

"I think the important reason is cultural. If you think of the lives that we have built for children, there is no place in this world of the child for the written language. I think that is a plausible explanation of why children don't learn to write very early. What's the point? It does not serve a purpose. For Robin it suddenly served a purpose. It gave her control, gave her power to do something that she could not do without it."

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"The static image of the computer in education is as a teaching machine. Clearly what I am talking about has nothing to do with that. The most common context for computers in this conference is calculator-and-computer, or computer-and-calculator as if it were one word. It's as if computers have something to do with

number crunching, with algorithms, with all that sort of stuff. Sure they do, but that's an infinitesimal slice of what their real importance is, and it is very far from those manifestations of the computer that are likely to touch on the deepest and most fundamental issues. For Robin the computer was not a number cruncher, it was not a sort of super calculator, it was not a teaching machine. It was an expressive medium, a pipeline to an important pocket of knowledge--alphabetic representation of language--from which she had, until then, been excluded."

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Papert described children playing with "turtle geometry," part of the geometric computer language LOGO. The children make shapes move on the computer screen by typing simple commands with numbers to control speed and direction. Then, at a certain point, they try using negative numbers--and the shapes all reverse direction, collapsing to their original positions. The children's surprise blends with awe at this unexpected power: "Negative numbers did that! Negative numbers did something aesthetically dramatic. An idea that was ritualistic becomes an idea of power to do something, an idea that resonates with deep feelings, with aesthetics, with desires."

"As we watch these children, it becomes inconceivable that anybody could be thinking about mathematics education ten years into the future without computers being very prominent. I mean, of course, this kind of use of the computer out there in the world, not a teaching machine in the classroom, but a use that changes the kind of initial contact between the child and the computer. These children learning to write programs are doing formal, written mathematics at an age when they are just beginning to make contact with numbers."