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You Can't Think About Thinking Without Thinking About Thinking About Something

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Although printed in 1970, "Teaching Children Thinking" was conceived in 1968 and bears the signs of the heady atmosphere of that time. Across the society change was in the air, deeply rooted assumptions were being challenged. On a smaller and less active but not less radical scale challenges to taken-for-granted ideas about children, about education and about computers energized my MIT seminars and ongoing discussions with an active group (Solomon, Feuerzeig, Bobrow et al.) at BBN[1]. We were sure that when computers became as common as pencils (which we knew would happen) education would change as fast and as deeply as the transformations through which we were living in civil rights and social and sexual relations. I still think this will happen even though the time needed is turning out to be a little longer than we imagined and the process more complex. When it does happen it will use the ideas that we worked so hard to develop back then.

In the meantime it is gratifying to see that many of these ideas have become part of the practice of schools and the lives of children. Some of my colleagues are disappointed that School manages to so dilute the ideas or so circumscribe their impact that they can be "integrated" into an essentially unchanged system. I have learned to see things differently through my Piaget-trained eyes. At the core of Piaget's theory of development is the process he calls *assimilation*: when new ideas are taken in by a child they are first reconstituted to fit the child's mental structures. Only later, through the interaction of many such elements, do the structures themselves change in a phase he calls *accommodation*. I am quite amazed at how educators who try to follow Piaget's ideas when thinking about children fail to understand that change in School, or any other complex system, must come about in the same way. School has to assimilate new ideas to its own structure before these structures can change. I see what is happening in educational technology today as a late stage of such an assimilation phase of the kinds of ideas prefigured in "Teaching Children Thinking." The first signs of the accommodation phase are just beginning.

An example of one of the ideas in "Teaching Children Thinking" that has had wide but diluted currency in education is the description of how a child might program a robot to follow a line. There is a direct line of descent from Teaching Children Thinking" via my 1980 book, *Mindstorms: Children, Computers and Powerful Ideas,* to the launching by LEGO of its robotic construction system named LEGO® Mindstorms ™, which has now introduced millions of children to programming along the lines described in "Teaching Children Thinking." In my model of change, the importance of this is that it gives another degree of depth and concreteness to the idea that simple elements of engineering and of computer science are relevant in the elementary school. This could only happen by filtering out some of the more radical overtones of these ideas. I'll mention two.

Of these the one that is most explicit in "Teaching Children Thinking" is the idea of migrating into the world of children at least some of the great benefits the CIC (Computation, Information and Complexity) sciences have brought to the way in which cognitive scientists understand thinking. Why should children not also use computational ideas to improve their understanding of their own thinking, learning and playing? Well, because this is not in the national standards! I predict that it will be.

An important resonance of the kind of work described in "Teaching Children Thinking" that was left implicit for reasons I cannot remember (we certainly spent many hours discussing it in the seminars) is the idea at the root of the calculus that local conditions can determine global form. The following examples show how key ideas of calculus can be made quite concrete in early elementary school.

Example 1
Draw a circle by the instructions "forward a tiny bit (in calculus language fd dx) right turn a tiny bit (rt d?) and repeat (integrate.)"

Example 2
Make a turtle seek a distant light by " if to the left rt d?, if to the right ltd A, fd dx, repeat."

The question that makes the difference between being optimistic or pessimistic about what is happening in schools is whether getting the ideas into the system in simplified form prepares the way for the deeper form or betrays it. I say, "Marry the man today and change his ways tomorrow!"

I end by mentioning two less specific "firsts" with which "Teaching Children Thinking" should be credited. At that time the concept of computers in education was synonymous with CAI (computer assisted instruction). I believe that "Teaching Children Thinking" was the first published paper to suggest that the child could be in charge of the machine not the machine in charge of the child by offering what was the a new image of children using computers as tools for creativity[2]. The idea that "teaching thinking" is appropriate in elementary school does have some antecedents but in 1970 it was certainly not current in the mainstream of American education circles. I see the movement that goes under names like "thinking skills" and "critical thinking" as something that came to prominence much later and was supported if not inspired by a wave of hype on the lines of "Logo teaches logical thinking." Reading "Teaching Children Thinking" should show that my own views were much more complex: Programming can be used to support learning about thinking, which is a very different claim from saying that in itself it improves thinking skills.

Notes

[1]Cambridge research firm Bolt Berank and Newman, now called BBN Technologies.

[2]I would appreciate hearing from any reader who knows of earlier publications of this idea.