Change and Resistance to Change in Education
Taking a Deeper Look at Why School Hasn't Changed[1]

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Abstract

This paper can be read superficially as a list of misunderstandings about the role of technology in education. Less superficially (though more controversially) it is an appeal to develop something analogous to developmental psychology to understand School's responses (past, present and future) to the demands and opportunities of the digital age.

The idea of the deeper look [3]

I am delighted to be participating in a conference whose statement of purpose makes it unnecessary to go through the ritual rhetoric about how learning is going to be so very different, how it will take place everywhere and all the time, how it will be individualized, how teachers will no longer be "preachers" but become facilitators. I assume that everyone here has accepted that kind of idea as given and is ready to go into deeper questions about how we can make all these good things happen.

[1] An edited and somewhat elaborated version of a talk given by video presence at the Gulbenkian Foundation Conference in Lisbon.
[2] Papert is in semi-retirement from MIT where he has served as Professor of Mathematics, Professor of Media Arts and Sciences and as LEGO Professor of Learning Research.
[3] The "deeper look" developed slowly over nearly forty years of work at MIT. Many people there made contributions that have been gradually assimilated into a holistic view. Among the more recent and most directly related to ideas expressed here, I want to acknowledge especially those made by Mitchel Resnick, David Cavallo and Uri Wilenski.

The word "resistance" in my title marks my intention to talk particularly about how to prevent good things from not happening; more precisely, how to minimize the effects (resistance) of currently dominant practices and policies which retard and distort development.

I'll be discussing a number of such mechanisms of resistance to change. Underlying everything I say here is a model in which two actors -- "us" and "it"-- interact. *We*, the technology-savvy educational innovators, are working to change *it*, the system of education. Most of the mechanisms of resistance I shall discuss come from the system: although it is occasionally useful to think about the system as "wanting" to change and looking to us for help, it is often necessary to think of the system as actively resisting change to the point of subverting our efforts. But it would be wrong always to blame the system. We also have to blame ourselves for letting the system get away with its mechanisms of resistance. I attribute a major part of the responsibility for the sluggishness of change to intellectual habits that have grown in the community of technology-savvy educators. Indeed the main purpose of this paper is to identify some (by no means all) of these habits and to present some suggestions about how to break out of them.

The worst of these habits comes from the best of motivations. We are an up-beat and down-to-earth community. Our work consists of making innovations that will be good for people engaged in learning. We judge our success by looking at the learning that actually takes place. How can anything bad come from that?

Well, it can. Focusing too narrowly on *how individuals are learning* can (in fact does) prevent us from paying proper attention to *how the system is not learning*. Of course we can't help noticing the fact that schools are slow to pick up the uses of new technologies and often use them badly. We notice and complain. But my argument will be that the patterns of School's responses to technology need a deeper, more scientific, level of attention.

There is a need for more holistic thinking, for what educators might call "developmental thinking," about the system. Where is it going in the long run, how do our actions fit into that long term development, what factors might retard or distort its development? We have to think about what is good for the system as well as about what is good for the individual learner ... and about whether there can be a conflict between the interests of the individual learner and of the system.

In a gathering of educators it is appropriate to develop this idea through an analogy between how School (or the "education system") develops (or doesn't develop) and how children develop (or sometimes don't develop). I begin by comparing two relationships: teacher-pupil and innovator-School. I am struck by how often we have a double standard in these two relationships: we attempt to "educate" School in ways that we would roundly condemn as methodologies for educating children.

Teacher and pupil. Teachers (among whom I would count myself) who have adopted any of several versions of "developmental education" or "constructivist education" have renounced the *transmission model* of education ("teaching by telling") which they see as reducing teaching to planting in children's minds a bunch of knowledge fragments that have been selected for some kind of intrinsic value. By contrast *developmental models* imply that the principal job of the teacher is not "telling" but "tending" -- nurturing a process of development in the child with its own internal coherence. The educator can influence the process but cannot force it and certainly cannot make it deviate from its own "laws of motion." Theorists -- think for example about Vygotsky and Piaget -- have proposed differing versions of what these laws might be; but what is important for my present point is shared by all those who think of education in terms of a developmental process rather than "learning one damned thing after another."

Innovator and School. It is remarkable how many developmental educators follow a transmission model in the dissemination of their work to schools. This double standard is apparent whenever a would-be constructivist innovator publishes a paper which, in effect, *tells* School to adopt this or that usage of technology and justifies the advice by

citing facts to prove how effective the procedure is. A developmental approach would give less weight to the procedure's direct impact on immediate learning than on an analysis of how it enters into a longer-term developmental process. Of course doing this goes against the short-term needs of school administrators and the policies of most funding agencies who tend to want "proof" that the *particular* procedure caused N children to gain M units on such and such a measure. So it is understandable that we sometimes succumb to the pressure. If we didn't, we would not get anything done. But if we succumb indiscriminately, what we get done is consolidating the system in its resistance to change. What we need is a developmental strategy that allows us to interact with the system on its own terms while at the same time tending a development of which it is not necessarily aware.

I have already complained about complaining as a response to School's uses of technology. To push this a little further I draw attention to seeing it as another manifestation of the same double standard. Good teachers don't *complain* about the patterns of development they see in children. They try to understand them and by understanding know better how to nurture them. My main goal here is to explore the use of concepts that have come from the study of children, to take a new (hopefully deeper) look at the patterns we see in schools, and through understanding, influence them.

As a starter I shall risk over-simplifying one of Piaget's experiments. I suppose that everyone knows it. A child is shown a row of eggcups each containing an egg and asked: "are there more eggs or more egg-cups?" At any speaking age the reply will be something like: "no" or "the same." Now, in full sight of the child, remove the eggs from the cups, spread them out in a long line, cluster the cups closely together and ask the same question. Typical five-year old children say "more eggs." Controversies about the interpretation of this phenomenon of "non-conservation of number" abound but do not affect its status as a litmus test to distinguish between educators whose response is to want to tell the child: "you are wrong" and those who respect the child's resistance to adopting "correct judgments of quantity" (which they have certainly had the opportunity

to observe in adults around them) as revelators of underlying processes that may be more important than "being correct."

I am certainly no believer in a literal interpretation of Piaget's description of the stages of development of children[4]. But I did take from my years of close association with this very profound thinker a deep respect for the resistance shown by children to being told to think in the ways that adults want them to think. Passage through a phase of "non-conservation" and a slow development to "conservation" of number is a real phenomenon.[5] But unlike many educators whose response is to seek ways to hurry the transition, I am more inclined to assume that the resilience of non-conservation serves a purpose and therefore seek to understand how it works. What cognitive mechanisms are responsible for children staying so long with ways of thinking that seem to be contrary to experience, including the experience of observing and interacting with adults?

A key part of Piaget's contribution to answering this question is his notion of "assimilation." The powerful tendency to understand the world in terms of a current intellectual structure serves as a protection against prematurely giving up that structure. The assumption here is that the structure needs time and stability to develop firmly enough to serve as a foundation for something else that will be built later. Following this thought I have begun collecting examples of assimilation-like phenomena in the way School has responded to the computer.

Much of what I used to see as failing to use the computer well to reform education I have come to see as *using it very effectively* for a different purpose: the system is protecting itself against changes it is not ready to make.

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[4] See my book *Mindstorms: Children, Computers and Powerful Ideas*.

[5] I discuss how categorical misunderstandings underlie the much cited experiments purporting to prove that babies have conservation in "What's The Big Idea", *IBM Systems Journal*. Vol.39, Nos.3&4, 2000.

In the following section I make this insight more concrete and expand it slightly by describing three situations to which it applies. In the final section I spell out some ways in which it can be used to guide strategies for educational change.

II
Getting Concrete
Four Cases of System Assimilation

1. Computer Labs and School's Immune System

When I first encountered personal microcomputers in schools in the late seventies and very early eighties every one of them had been brought into a classroom by a visionary teacher who saw the new technology as a means to break away from some feature of school such as a lock-step curriculum, an artificial separation of knowledge into subjects or the reduction of learning to being told. These teachers did not worry about how the computer work was "aligned" with the school curriculum or with the national standards. Quite the contrary, it was explicitly un-aligned. It was being used as a revolutionary instrument to subvert the system.

By the end of the 80s, the situation had changed quite radically. There were just as many, in fact, many more visionary teachers trying to use computers to break away from the bounds of a restrictive school system. But there was now a much larger presence of computers in the hands of the system. As the system took over, the computer was neutralized. Systems don't want to change! They have "immune systems" to protect themselves. One of these worked through assimilation of the computer to School's ways of thinking.

Thus the computer was taken out of the mainstream of learning and placed in a special room of its own (misleadingly called a lab), with a special teacher and it was either used to deliver the standard curriculum in traditional subjects or was forced into a curriculum of its own. It was "schoolified" -- it had been brought in line with School's ways of doing

things. This is exactly what assimilation means. A threat to the status quo is neutralized by assimilating a foreign body, in this case the computer, to something that fits better with the system's structural form.

> Note: My description of the creation of labs as a process of resistance to change must not be taken as implying that the teachers in these labs did not often do very wonderful things. Many did, just as many teachers in traditional math or history or music classes often do wonderful things. But the wonderful things are of the kind that can be done within the traditional school. They are far removed from the vision of breaking out of School's ways.

2. World Wide But Inch Deep

My second example of resistance to change by assimilation is what has become a new standard use of computers in the classroom. The computer and the Internet open a new kind of threat to the School paradigm. The style of teaching by preaching and the expensively printed textbook are both closely linked to the paradigm of a one-size-fits-all curriculum. The Internet opens new possibilities for students to learn foundational skills and fundamental ideas though material chosen to suit the individual's interests, tastes and style. But you would never recognize this by seeing a teacher in front of a classroom pulling material off the Web instead of making transparencies. This is undoubtedly a more lively and generally better method of presenting the lesson. But it is still a lesson in the traditional framework. The teacher is still setting the agenda.

3. IT

I passed briefly over the use of the Web to support traditional teaching because it is a special case of a deeper issue raised by looking critically at the name "information technology" which I see as turning attention away from the most powerful educational uses of computers and reinforcing an essential aspect of the School paradigm.

For most people it is obvious why that name should be used. Their images of what a computer is good for are dominated by analogy with the information media: the computer linked to the Internet is a source of the same kind of stuff as newspapers and television. All are sources of information.[6] In the popular imagination the computer is assimilated to the class of "informational media."

However this is only one of many functions served by computers. Consider, for example, the computers in the engine of your car. These have little to do with information in the popular sense of that word. They are just components of this machine that are found in many machines: there may be one in your toaster, there are hundreds in every airplane and thousands in a space shuttle. The effect of these computers is to make possible more complex functions, using more complex constructions than were even conceivable in pre-digital times. They have had a revolutionary effect on what can be done. But they have this effect as a stuff, as a material out of which machines are constructed. This is not an informational use; it is better called a constructional use.

To keep the point in mind I like to use the term "digital technology" as a general name and distinguish between its informational and constructional aspects. These are equally important in their presence in the world but very unequally perceived by the public which finds one of them easier to understand and so tends strongly to assimilate digital technology to IT.

Now the real point I want to make is that this split between the informational and the constructional sides of digital technology happens to run parallel with a split between two sides of learning which could be called informational learning (or learning by being told) and constructional learning (or learning by doing and making.) This parallelism has a mischievous consequence: School traditionally emphasizes the informational side of learning and this biases it to focus on the informational side of digital technologies which further reinforces the informational view of learning. And all this would be fine except

[6] The existence of a more technical sense of the word "information" does not affect popular understanding.

that it is the constructional side of the digital technology that has the more revolutionary and hard to accept consequences for Education.

We are coming to the crux of this story. The play between the two kinds of split between informational and constructional leads to an assimilation of the new technology to the form that is least threatening to School thus providing another example of resistance by assimilation. But I need to spell out more explicitly both constructional sides and how they apply to School.

I noted that what the constructional side of digital technology has brought to engineers is the possibility of carrying out projects of far greater complexity and sophistication than was even conceivable in pre-digital times. I now note that what is true for engineers is also true for children. Digital technology opens possibilities for children to carry out projects that are more complex and also far more connected to sophisticated powerful ideas than anything children could do in the past.

Examples that I have seen in my own research include making a real video game and building a robot. What is remarkable is that children as young as six or seven are able to do these things at a serious level and children of 8 to 10 can do them quite competently. How do they do it? The video games are programmed in modern versions of Logo, the language I initiated nearly forty years ago. The robots are constructed using a modified form of the computerized construction sets that LEGO has named after my book *Mindstorms: Children Computers and Powerful Ideas* from which the idea was derived. These children are using computers in ways that are not well described as "information technology." They are working on the constructional side of digital technology.

To my mind the deepest significance of the work being done by these children is seen by its relationship with the long debate in education circles between School's paradigm for learning and those that involve more doing and less being told. I maintain that every profound thinker who has looked at School with an open eye rigorously trained in another field has found it lacking in exactly this respect. Whether it is Dewey in the USA or

Montessori in Italy or Piaget in Switzerland or Vygotksy in Russia, they all agree that learning would be better if it were more experiential and less didactic. The deep significance of digital technology for education is that it makes possible the policies advocated by these thinkers. The idea of learning by doing something in which the learner is really interested existed long before computers. But in those days it was far harder to find things to do that would both capture the imagination of young people and also bring them into contact with fundamental powerful ideas. This paucity of learning-rich things to do provides the real explanation of progressive education's failure to take firmer root. The technology now offers it a second shot. But School defends itself by hiding behind an interpretation of the technology that excludes the most threatening aspects.

4. Computers, TV and Language Labs

I shall refer later to the more positive aspect of a mostly excellent book, *Tinkering Towards Utopia*, by David Tyack and Larry Cuban which comes closer to any other writing I know to sharing my view of the importance of a phenomenon similar to assimilation in resisting school reform. Nevertheless the thinking of these authors is vitiated by an assimilation that may be even more powerfully obstructive than the ones they do discuss.

They are by no means the only commentators to issue a warning against optimistic predictions about computers and school by recalling a history of failed predictions about the revolutionary consequences of "other technologies" such as educational film, TV, language labs and many more. The assimilation occurs in putting computers in a common category with these "other technologies." Here, as always, the way people categorize tells us something about their conceptual framework. To see what it tells us in this case we consider the Sesame Street version of a common IQ test question: "Which of these three is not like the other two?"

I am sure that everyone knows these odd-one-out questions. Applied to the trio: Banana, apple, lion, the expected answer is "lion." Of course there is no absolute right answer. In some imaginable circumstances a cryptographer might pick on the fact that the words "Banana" and "lion" have an even number of letters yielding the answer “apple.” The tester thinks in terms of right and wrong; the epistemologically oriented psychologist thinks in terms of what it reveals about the individual. With this thought in mind consider: "Textbook" "TV set" and "computer"? For me the dominant response would be to put the first two together as "teacher technologies" and to make the computer the exception --- in my system of categories the importance of the computer is its potential to be a "learner's technology" while the other two are “teacher’s technologies.” From this point of view, success or failure of pre-digital technologies has nothing to do with expectations of digital technologies.

Although I have not had the opportunity to apply the test to Tyack or Cuban, their argument depends on thinking, and assuming that their readers will think, that computers belong with TV, film, language labs and the like. I can imagine a number of explanations of their way of thinking. It could be a case of Alan Kay's principle that "technology" means what was invented after you were born. It could be explained like the over-simplified interpretation of Piaget's conservation experiments as showing that children are unable to escape the influence of appearance. And most likely many factors contribute to supporting it and, incidentally, one another as well. But I believe that the dominant factor is School’s tendency to assimilate learning to “being taught.” School’s intelligence simply does permit the distinction between “learner’s technology” and “teacher’s technology.”

III

What To Do

Piaget's theoretical framework gives resistance to change a positive role: it makes large structural change possible by protecting the system against the constant buffeting of chaotic small changes. But of course invincible resistance would defeat this purpose. Piaget's theory of development postulates processes of growth within the pockets of stability (he would say stages, but we do not have to go along with that) that eventually become strong enough to overcome the resistance. In his language, development happens when equilibrium creates the conditions for the growth of a new disequilibrium.

All complex systems have mechanisms of protection against change: otherwise they would not have maintained themselves long enough to become complex systems. Good analogies to the case of School are the immune system of living organisms and the analysis of resistance to paradigm shift famously analyzed by Thomas Kuhn. But I know no reason to suppose that all complex systems have mechanisms for emergence from the stability. Certainly some go for very long times without development.

Where is the system School in this respect? A purely empirical look at history would suggest that it is a highly stable system. For example the book already cited by Tyack and Cuban provides a history of attempts at education reform in the USA during the greater part of the twentieth century. They see a recurrent pattern of failure of reforms that can be summarized as "the reform tries to change School but in the end School changes the reform." In the kind of language I have been using: the reformers offer new forms of learning but School assimilates them to its own ways. Thus Tyack and Cuban offer more than an empirical view of stability, their story suggests the presence of powerful stabilizing forces.

Thus far I am in agreement. One might even have to agree that there is every evidence from twentieth century history that the system not only has powerful stabilizing forces but also showed no sign of development of internal disequilibrium that will allow it to

break out into a new stage of development. Where I disagree is in seeing the process of "becoming digital" as a source of the tensions that will break the stability. For reasons I cannot outline in a short time here I believe that the growth of these tensions is inevitable and even accelerating. Instead I make the easier case: whether or not the tension is inevitable, it is open to this community to bring it into being.

To formulate a strategy for doing this I return to my image of a double standard -- our reluctance to take the same stance towards the system as we would to children in our care. Doing this involves some audacity. When we deal with children we treat them with respect but we have no doubt in our own minds that in certain essential respects we are "ahead of them" -- we are in a position towards which they are developing. We have learned (I hope) to enter their worlds with them; but we do not abandon our own intellectual vision for theirs. But in education our community does exactly that whenever we agree to statements like "the computer is just a tool" or "the technology should serve the curriculum not shape it." Indeed we accept this position of inferiority every time we label a conference as "Conference on Computers in Education." Those others don't label their conferences as "Conference on Paper in Education." They use the phrase "education" without qualification because they are convinced that their form of education IS education and that our function is to serve their goals. This is the ultimate assimilation: the bearer of the new forms of learning is assimilated to the servant of the old. The others all follow. It is up to us to decide whether to be assimilated or to stand up and claim our position as representing the future.