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Edited Transcript of a Video History Interview with Seymour Papert
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DKA: I wanted to ask you a few questions about your upbringing. You of course grew up in South Africa. Who or what had the most influence on you as you grew up?

SP: The first thing I think had a tremendous influence on me was my father. He was an entomologist studying tsetse flies, and he would set up a camp in some jungle somewhere or wilds. It really was a self-contained environment for his studies. That had some impact on me as I was very young – the concept of making a transparent self-contained world that you can really understand has stayed with me ever since. I see that as the core of most of my interests, both in artificial intelligence and in thinking about education.

The social conditions of South Africa also impacted me. I had grown up, my first few years, in this environment where I was just not aware of racial issues. Most of the people I saw were Africans, but there were people who were separated by skin color. Then later when we moved to the city and I went out into school, I began to be shocked by this sharp and growing segregation that surrounded us in South Africa. Very early on I was drawn into taking a position, getting involved in efforts, especially those led by a man named father Huddleston, a prominent Anglican minister in South Africa. At elementary school I ran a newspaper, we raised money for Father Huddleston's enterprises. That became sharper and sharper for me, leading to sharper and sharper conflicts with the school, and planted in my mind, intense preoccupation with how people can think things they think because I just couldn't make sense of what people thought and how they thought.

A critical event for me was at some point trying to organize evening classes in the school for African servants who were working as gardeners and cooks and nursemaids for the white families who were among the most prosperous in Johannesburg. And the school wouldn't allow it. When we called a meeting for parents to try to persuade them, they would allow it either. They raised arguments like, "These people might have diseases. How can they sit on the same chairs as the whites?' This kind of, 'How can people think that?' became a preoccupation, more and more. It drove me into taking sharper and sharper political positions, and also into an interest of the philosophy of the mind. That also fed into learning and education.

DKA: So your notion that they system is not the way it should be is something that grew from a very early age.

SP: The system is not what it should be, and that it could change and that you should do something about it. I had this feeling that I had to be involved in some sort of activist role, but also making that activism lead to fundamental questioning about the nature of the mind and the nature of thinking and the nature of society.

DKA: You went on to study mathematics at Cambridge. Why Mathematics?

SP: I began studying mathematics in South Africa. I had always loved mathematics. I had not thought of this as something I would do professionally. I was always more interested in philosophy. When I started university in Johannesburg, we were still on the very end of the Second World War. I didn't have any thought of going overseas. I soon realized that if I was going to exist as I thought at the time, inside an academic framework, but being politically active - trying to change things – you couldn't be doing philosophy. As I think it has been inside a lot of totalitarian countries, mathematics provides a beautiful cover because it's sort of politically neutral. So that's how I got into being a mathematician as a profession.

I stayed in South Africa a lot longer than given my background, what I was doing academically and so on, than I would have because of the political involvement. Things were getting very, very hot, and I thought I would let them cool off and get away to Cambridge. As things turned out, it got worse and worse in South Africa. I didn't think it was meaningful to go back. So that left me doing mathematics in Cambridge.

When I left Cambridge I went to Paris where there was a much more exciting mathematical atmosphere at the time. This was in the 1950s now, but I continued my interest in the philosophy of the mind, and how people think. I was sort of circulating in radical political circles – circles of people interested in thinking, of the mind, and I ran into people closely associated with Piaget. They spotted me as a potential recruit for Piaget, who was peculiar in his approach to studying children. He was gearing up at that time to rethink the development of children right across the spectrum of intelligence. That year he was in the process of number, and for Piaget to study the concept of number is very different from the usual psychologist's approach who sees fairly trivial mathematical meaning. They don't know much mathematics anyway. Piaget always thought that understanding children's mathematics touched on the same issues as studying the foundations of mathematical thinking, historically and philosophically.

DKA: Had you thought about children and mathematics before?

SP: I had really not thought about children and mathematics. I began to think about children and mathematics because of having several conversations with Piaget in Paris over a period of about 6 months. At the end of that time he invited me to spend the next year in Geneva. He wanted to find collaborators who really knew mathematics but really were interested in the human side, and how mathematical thinking could happen.

I hadn't thought about children and mathematics much but I had thought about children's thinking, and that clicked. So I went to spend that year with Piaget in Geneva and that really clicked so I spent nearly 5 years there. But in the meantime my independent interest in computers was growing and I saw that as the direction for study, about how the mind works. At a number of conferences I ran into people from MIT, and we developed a relationship that and got closer, and they invited me to come for a few weeks.

DKA: What was your first encounter with computers?

SP: I made a computer when I was a first year student. I didn't know that there was such a thing as a computer, but I had gotten into arguments with the philosophy professor at a university in Johannesburg about whether there could be laws of thought. I made a machine that did little syllogistic reasons. It was built out of relays, of lots of wire, but it could make deductions. Because of that, it drew my attention to people who told me about real computers that were just developing. There were only a handful of computers in special places.

DKA: Did you use computers at Cambridge, or when you were with Piaget?

SP: When I was at Cambridge there weren't any computers to use in the sense that you could use them for your daily work, but I looked up the people, the core of the cybernetics movement. Really that's how I met the MIT people, because I made a contact with them.

So I had a personal involvement with the idea of the computer. That drew me into the cybernetics people. I did not have a bad time with the idea that putting computers into the hands of children could be a source of powerful change in how children think. I saw computers as a way of understanding how the mind works, how the brain works.

DKA: So your interest in coming to the Media Lab, actually coming to MIT before the Media Lab established, was to do what?

SP: I basically wanted to understand how intelligence worked. With Piaget this is really what I got drawn into, how does this thing develop? How can such a thing happen whether it was mathematical thinking or logical thinking? And making a machine think, or thinking about how to make a machine think, was a way to come to grips with this kind of problem, and whether I can bring my mathematics to bear on something connected to my other interests in the nature of the mind. That's what I was thinking, in entirely those terms.

On the first day almost at MIT, when I was sitting waiting for someone to come back from a meeting, there was a computer just sitting there. The idea of a computer just sitting there was amazing. I started fiddling with it and when my friend came back I almost apologetically said, "I've been playing with the machine. I hope it's okay." I was amazed when he said, "That's what they are for." I realized that I could use computers to carry out projects that had been bothering me for some time. There were a bunch of questions that had bothered me. I didn't know how to tackle them, and all of a sudden I could in days do what seemed hopeless before. This was the beginning of the reformation. This computer could mean intellectual power, and amplification of intellectual power, and we could give that to children. If we could give this to children, wouldn't that really do what all the educators had failed to do with Piaget and other psychologists' ideas, and really change the way children think and develop?

DKA: What computer were you playing with at MIT?

SP: It was the first model, PDP 1.

DKA: So you had an interactive interface to that?

SP: Well in a sense yes. The machine had no graphics. There was no screen. It had a lot of blinking lights and it had a keyboard. You could type at it. Mostly you pushed a lot of switches.

DKA: What was the process that led you to developing the Logo computer language?

SP: From that moment when I woke up to the fact that computers could be a source of intellectual power, I wondered how could we give this to kids, and how would a kid be able to take hold of that machine and do what I had done with the machine? I did a lot of sophisticated manipulation, and thinking, and surveying of the machine language terms. Kids couldn't actually do what I did, but could we create something like an interface so that a kid could make a computer do the kind of thing that would be in his interests.

LOGO emerged as one of several ideas for making it concrete, in putting kids in control. Kids could program the computer without having to know about binary, or compilers, or all the stuff that in those days stood between the computer and anybody actually using it, except for the most mechanical kind of way.

DKA: That was such a radical idea to think that you could actually make this resource available. Did you feel that you were all alone, or were there other people that were equally interested in this?

SP: No, from the beginning there were people that were interested in this idea. Most of the people around me worked in what eventually turned into the artificial intelligence lab. Everybody around there was highly radical in their way of thinking, and it seemed obvious to them that this would be a great thing to do.

Actually the first real implementation wasn't there. It was at Bolt Beranek and Newman, a research firm in an education team. They had a grant for developing computer uses for high school kids. And this was mostly developing uses of a fairly conventional computer language, a sort of pre-cursor to BASIC. This would be incorporated into a high school curriculum, but they were very open with us. They had us come and consult there, and they would ask, "This would be great for kids, but how about younger kids, and very young kids?" So they liked that idea and they had funding to be able to make the first implementation of what eventually turned into Logo.

DKA: What is amazing to me is that Logo has continued to not only grow and develop but also change over the years and continues to live on now. Is it surprising to you that it has had that long life, and how does it look to you now?

SP: I think it's great that it has had a long life, and I think that what paid off was working very hard in the beginning at making it computationally pure. It is built around what was then and really still remains now, core concepts of computer science. This I thought was very Piagetian in the sense that, don't just make a surface structure that is defined in terms of user interface, and do this and this will happen, but really build it around the deep ideas of computer science. So really making it procedural clean, is an example. Because it was well built in that way, we could give it continuity so that as computers became more powerful, we could bring more buried activities into the scope of what kids could do with this thing. We were able to bring it up to date without having to really fundamental mess around with its basic principles.

But it might be running out of steam. I have been spending a lot of time thinking about the next generation in that tradition of computer system, working especially with Brian Silverman who was the main architect of Microworld. We're spending a lot of time trying to rethink what would a 21st century language be like. For me it's an open question whether it would still incorporate Logo or start off with one of several other really different directions that we have been thinking about.

DKA: One of the constants seems that it's important not just for children to use computers but to program them in some way. What do you see as most important?

SP: I would distinguish a number of different goals, and I think by bringing them together, they gain a lot by mutual reinforcement. One is giving the kid a lot of control, so the kid can do enough with his computer so that imagination can run, and the kid can figure some crazy idea and be able to do something about it. So it's just the sheer power of the machine, and I think that necessarily involves programming of some sort. There are various attempts to make systems that may force the child to do the things that somebody else imagined the child would be doing. You need something that has many of the elements of real programming to be able to follow your imagination. So that is one aspect.

A second aspect is more intellectual. If you think of programs as a fundamental thing, controlled constructions, and procedures, and variables, and computation environments, these touch on some of the key ideas we value. I think simulation and cybernetics, it's programming, and the modern understanding of ecology and animals, it's programming. So I think familiarity to those ideas is key, a central part of being in at least the scientific side, and I would think the larger intellectual culture of our times. These ideas are really, really important and powerful for children to acquire.

DKA: So programming, or computers as a tool that can be dynamic provides opportunity for a child's learning?

SP: Yes, so you can come into contact with the most intellectually important ideas of our times, and at the same time, these very same ideas give you immense power to do all sorts of things. It gives them the ability to put together a project that is very appealing, gives the children a sense of power and brings them in contact with deeper ideas.

DKA: What is interesting to me about your career is that you have been working with this notion of intellect and computers for a very long time. You have been through many generations of technology. What is happening today that is fundamentally different, and what can be done, what are your goals, what do you see that you dreamed about when you first started thinking about this?

SP: I think what is fundamentally different today compared with say the 1960s, or 70s or maybe even the 80s, is the penetration of serious computer power into the lives of children. Basically when I started working with Piaget in the field, the conflict that was really troubling is that when you look at children outside of school, you see them as extremely powerful learners.

And by uncovering successive layers of what was going on, Piaget was able to show us that there was even more learning than we thought. He showed us that much of what children learned is not actually taught.

Then when you look at school and you see how they are teaching them different things, and it is enormously difficult and expensive, and underlying all of this is that many of them don't even succeed. What is the difference? Why is it that algebra needs such enormous efforts, whereas that the things that children learn, like language and talking and logic and getting around a space and all of the rest, seems to happen so naturally? The answer I come to is that children will easily learn intellectual material, they will construct intellectual material, if they've got the materials for constructing it in their culture. School just can't do that. They are trying to change school by having more effective teaching, or Piagetian curriculum. It just doesn't work. It's only when it's part of the culture, and is in their lives that it can really become part of that learning which happens in this natural way.

Early I looked around and asked, how can the culture of children work? To set out to change the culture of children's learning – this is too grandiose even for me. Nobody can set out to do that. It doesn't make sense. So you could ask yourself, ""What developments in the world have the structural capacity to induce, or create the conditions for changes in children's culture?" Pretty early it was clear that the computer, and only the computer had that potential, and now we are seeing that happen. It's only in the last four or five years that you can say that computers have infiltrated into the culture of very small children sufficiently to change quite radically the way they learn and the way they think. Of course we do a lot more with these computers, but I don't think that is as important as, it's part of their lives. It has become a mass phenomenon, and not just an occasional, spotty phenomenon.

I think there is one aspect that makes a fundamental difference and that is connectivity. The computer that this child works with is connected with every other computer in the world, and that is mind blowing - the idea that children get at sources of information, or meet other people who share their interests. This radically changes what materials are available and the structuring features of children's thinking as they play with it. It's that concept of structure that is the most important thing I got from Piaget, in that what the child learns is not just a connection of a lot of things. There are some key structural ideas, and that's why I think computational ideas deserve to be among those which Piaget identified. The idea of conservation and reversible actions, and of combining two intellectual actions together, having a connection of piece, like atoms that connect all the substances in the universe. I think that gets picked up in Lego pieces that you build any structures from, and these are powerful structural ideas. Computation is second most important, maybe the most important new idea that has the structural possibility.

I think this is where the whole contemporary thinking about is just going in the wrong direction altogether, because they are thinking of the computer as a delivery system. They think of it as a delivery system for all of the old stuff and they're not really changing the ways children develop. They are thinking the way everybody thinks.

DKA: Seems to me that your ideas of the new power of computers in education really challenge many of the basic structures of education today – the grade level structure, and the disciplined curriculum structure. What do you think are some of the ways that the basic structure of education as exist today need to change because of the role that computers can play.

SP: The most dramatic thing you would see if you could go in a time machine to a school of the future is, there will not be grades. This idea of segregating children by age makes no sense except as an organizational means to hand out their curriculum information bit by bit in a systematic way. There is no other justification for it. Nowhere else in life do we think it necessary to segregate people by age. Even with small children, everyone would agree that the old style extended family where people of all generations and all ages live together, this was a much better environment for individual development of values and social sense and so on. We do this in school because we think that the only way children could get access to knowledge was having it handed out bit by bit through a curriculum. We're moving rapidly into a time when you can get knowledge when you need it, and can get it for use rather than for storing away in some banking system in your mind. This is the way it's going to be – the idea of curriculum and the idea of grade level that goes with it will be thrown away.

Kids would learn by being engaged in projects, long-term serious projects in the course of which they encountered the need for knowledge, and found the knowledge, and found other people that could help them, other kids. Peer teaching in a class is a tiny little step, but really the chance that somebody in that particular class of 30 kids shares your interest and has the knowledge that you might want is pretty small. But the chance that somebody in the world does is an absolute certainty. I see the use of connectivity moving towards being able to identify the people who can share your interests, with whom you can work with and share knowledge, and help one another. This is a more natural way of acquiring knowledge. It's what children do before they get into school. It's a way that professionals do, anybody in knowledge work, whether a scientist, a journalist, a wrier, a businessman. You get knowledge when you need it and not on somebody else's agenda. It's not written down on a curriculum that on the 17th of May you should learn such and such.

The concept of school and all its basics structural features; curriculum, grades, teacher in front of the class, little exercises, tests, all this school structure becomes antiquated. It's so frustrating that in the shadow of this energy and resources that are being put into trying to improve a school system that doesn't have any future anyway. It is in trouble exactly because it has lagged behind. The real troubles in school are because it's getting harder and harder to sell it to the kids, to legitimate it in their eyes. They can see that this is not in the spirit of the modern world. So they resent it. They resist it. They reject it. I can't believe that all of a sudden we find that 40% of our kids have some sort of learning disability. Is this some new plague like AIDS that suddenly descended on the world? I can't believe it. It can't be just because of some biological function. It's because of the nature of learning environment as it is today. School was designed centuries ago, and has lagged behind the development of society. All the people who have said, "Let's go back to the good old days," are in fact trying to solve the problem by aggravating the cause of the problem.

DKA: If you take a project approach to learning, what does that really look like? I have an image of people of different ages in a classroom, working in teams. How does it look to you?

SP: When you start with projects that can be done in the school setting, one of my favorite kinds is children making video games. This is interesting because the video game is an important part of culture and they see that as an important thing. The fact they attach importance to it means that making one is something they find interesting and cool and important.

So we have tried various settings, like summer camp full time for a couple of weeks, or in the school for an hour a day during the school year. Kids work on this long-term project – and long term is the essence of it. It's very different from the school exercise when you spend 10 minutes or an hour and then you get onto something else. This lives with you. You get an idea, it might come overnight or in a conversation, or somebody suggests something. You have time to try something, and if it's not working you do something else. This is more like real world interactions with knowledge and getting things done.

Something else we have done is adding to traditional Lego, tiny little computers that can be put inside the model and sensors and motors, so you can make up a computer-controlled device, a robot, a vehicle that can avoid obstacles. There's just no end to the kinds of things you can make.

These are longer-term projects, and all those projects are things I would like to see more of. They are still artificial projects done for work. In schools they are done with this sort of educational intention, and that needs to be stripped away. They should be intellectually rich things that are done for the pure pleasure of it. They should be enriching and leave you knowing a lot more as a result of doing this.

I would like to see more projects in that are actually socially valuable, they are contributing not only to the growth of the individual that does it, but to the society as a whole. We have seen a few examples of children becoming environmental activists using the technology. That's a direction that's going to increase. Having children participate in the care and education of other children is another important area. We have worked with children who have been in a lot of trouble in school and almost dropped out, who have been put into learning environments where they can master the use of computers, and then could act as teacher aides for schools that are having trouble introducing technology into the classroom. So for these kids, introducing technology into the school can become a project.

There are a lot of kids that are developing materials out of the Web. There are kids making money at that at a very young age, those are projects. Then there are projects that are important sociologically. You can't approve of their goals, but the so-called hackers, young kids who have quite a bit of expertise to break into someone else's computer system. It tells you something about the vulnerability of the computer. You find these virtuoso kids who really get to understand this thing, nobody taught them, they learned it. They learned it enough as their own project, on their own agenda, to be able to break the system.

We went to buy a car recently, and I could get my grandson to help in a way that was not possible in the past. An 8 or 9 year old kid can today get into the Web, the Internet, get information not only information from manufacturers about cars, you can get into discussion groups, you can get all sorts of information about any make of car you are interested in. So really investigating the purchase of the next car can become a project for a child that really has meaning in terms of contributing to the life of that family. The child is no longer simply somebody to be looked after and taught, somebody who is not really doing anything useful until they grow-up and can work and make important decisions. Small children can make important decisions and be participants in the life of the family, and in so many ways that I don't know how to imagine, in the life of society.

I have been involved in a lot of projects with industrially underdeveloped countries. A country that calls itself a developed country is least likely to change, smug and self-satisfied. We're working in Thailand trying to develop projects in a village, far away in the mountains, where we would create a technology center, where modern technology could be present, where anybody to learn.

That is just in the early stages, so I am talking hypothetically, but you ask, what could it look like? In this context I see that it will be young people especially who will get in there and learn to use this technology. But technology can make a difference in the lives of all in that village. It can make a huge difference in communication, getting marketing information, finding out what alternative crops might be grown and how to look after them in dealing with a plant disease that might come up, or they could learn how to deal with human medical problems. So that is an example where the technology make it conceivable that people independently of age can be part of the social, economic, and artistic and cultural fabric of the community they live in.

DKA: What's the role of a teacher in a structure like this, does the teacher ensure that as people become interested in their part of the project, that they understand how to get more skilled to solve a problem that they need to solve, whether it's mathematics or language? How do you see the role of the teacher to make sure that the student is progressing?

SP: I certainly don't think that teachers will become unnecessary. Maybe I would shift concept of teacher, if teacher means someone who stands there and teaches you stuff, or her or his agenda, I think this will not be very important. We might need a little of this, but I think that should be a secondary part of the learning process.

On the other hand, a professional in child development whose function is to facilitate, aid, watch over, the development of children, I think we need more of them. As children become more productive, and as the learning process becomes more productive, we'll be able to afford to have, and be more willing to develop the resources to having more of them.

I think they would have functions like, if they see an individual kid is going along a too-narrow track, and maybe steering them to try other things. Or maybe it would not be necessary to exert any more pressure than a suggestion to widen out the activities, open up new perspectives, talk about what's been done to bring a richer, more mature understanding to bear on what the kid is doing. This has a role in consolidating knowledge. Kids can learn about mathematics by doing something that is mathematically enriched, but at some point it's valuable to have somebody say, "Okay, let's tidy this up." So they look at the big ideas, and the main structures similar to the way we learn language. We learn to speak first and then we learn the grammar and the linguistics. In math, we should learn to speak math and then study the principles of mathematics, and that's the role of a specialist teacher who can perform that function.

DKA: I can see in this model how it might lead to learning more language, to communicate more effectively to someone else you have to learn how to express yourself better, and you may draw from the direction to draw from that tool set, but would this ever lead a child to learn geometry or algebra in the traditional sense, or should it?

SP: We have to look at what you mean by the traditional sense here. If traditional sense means taking serious these problems like, 'Mary bought 20 fruits and some were pears,' and etcetera, I hope not. They are silly questions and silly problems. I see 6 and 7 year old kids now who use Logo, getting the idea of a variable as part of their programming. So this idea that we embed it in a particular artificially defined slice, which we call school algebra, which has very little in common with what a serious mathematician would call algebra by the way. The variable is a powerful idea, but this should be made part of a child's life from a much earlier age so that those ideas will be learned but they won't be artificially lumped together in a course called algebra. Serious work needs to be done.

This is one of the things I spent a large amount of my time on. I wish I could spend more, but a lot of work needs to be done on really conceptualizing, reformulating key concepts and areas of mathematics in a form that can be naturally learned in this next context. In LOGO we have the concept of turtles and turtle geometry, which is a way of recasting a bunch of ideas about geometry, some of which belong to school geometry, some of which really belong to material that is usually studied at college level, with names like differential geometry and differential equations. There is something that cuts right across all of those that can be accessible as both a valuable, powerful tool, and rich source of intellectual ideas to children.

So yes, the big ideas, the powerful ideas in mathematics can be learned by children in context where they actually need them and use them, and are really valuable. Using variables in algebra causes, "ho, hum, why should I do that?" But if you are making your video game, a shoot-em-down game, and you want things to happen at different speeds, and depending on the speed you want the trajectory to be different and that shows why you need variables. In fact you pick it up more easily in a much more solid way than in an algebra course.

DKA: So your notion is that if you were developing a video game of that sort and you run across the need to understand that, it would be at that critical learning point that you begin exploring the notion of variable?

SP: Yes, you get the idea of variable at the time when you need it.

DKA: One of the things that is interesting about your notion is that it seems to argue that there needs to be a very different look at learning in the home, and the value of the computer in the home. I know you've been doing a lot of thinking about how much learning happens in an institution, like a school, how much learning happens in the home. Do you see that learning at home taking on a different character in the years to come?

SP: I think already learning in the home is taking on a different character. I like to conceptualize it in terms of three rough stages. Roughly speaking, stage one starts with a baby that comes into the world with this learning instinct. The baby wants to explore everything, sounds, people, and in the first few years learns an incredible amount by self-directed, experiential explorations. That child does it by exploring an immediate world, which can be touched and felt.

Then that begins to run out and questions arise that can't be answered by their immediate experience. The child hears about elephants, how do elephants eat, and hears about ancient Rome and what happened there, and out in space, and tigers, so these aren't questions that can be answered in a traditional setting in an experiential way. They can only be answered by accidentally running into the information or by asking a parent. So you become dependant on the adult. You become more dependent on verbal information, rather than experiential knowledge. The ultimate development of this is the pure stage two, which is school, where you give up learning and submit to being taught. Everybody loves learning and not being taught basically. This is a trauma that we didn't have any other way of doing it. At school, some of the children, those who weren't too damaged by the trauma, acquired the skills, of not only reading and writing, but learning how to use a library, how to use an encyclopedia. They acquired the skills and retained the curiosity of seeking knowledge, and these are the people who become successful products of school.

Then they run into stage three where as creative adults go back to something more like the state where you learn the information you need when you need it. Now all that's to say that the big role of the new technology is to make possible to bypass stage two. We see a three-year-old kid can go and load a videotape in a VCR and spend the next half hour looking at a tape about tigers. When I was three, there was no way in which I could decide myself the way to spend the next half hour in a world of tigers. We're only seeing the scratches on the surface so far, because the way we still do it is text-based. It's not designed for a three or four year old, but it's getting there. We are beginning to see emerging, access routes for small children. In a very short time we will see a huge explosion of possible ways in which many small children can get technical access to knowledge.

This is science fiction from the future. This isn't something that depends on people making big policy decisions. It's just happening, willy-nilly, whether we like it or not. I like it. Although I see it raises many, many problems, among those of increasing independence. We really don't know very much about the consequences of different kinds of dependence relationships between children and families or parents. We never had the opportunity before of seeing independent intellectual development of children, and I think we really have to seriously re-think fundamental questions about relationships between children and parents, what parenting means, and what kinds of materials is good to have around. What I think is very bad is to import into stage one the kind of learning that is traditionally in schools, and yet there is a lot of money to be made out of that. So we've got a huge industry that is making so-called educational software that will teach the three-year-old what normally be learned after going into school; arithmetic, or spelling, or writing. I think that's pretty bad, and parents ought to think much more about it.

I'm trying to ignite that spark. I wrote that book, *Connected Family*, which had a lot of weaknesses, but it was a first stab at trying to alert parents, to see if we could stir up more discussion and thinking among parents about this issue. I would like to do more things like that. I'm thinking of making a television series. I think I would like it to be like Carl Sagan's "Cosmos," but it would be about learning. And learning could be as exciting and as visually dramatic and interesting as the origins of the universe. That's a kind of action I think needs to be done much more.

Parents are faced with many issues. Take this whole thing about mathematics – in the past they are learning their multiplication tables, and adding and subtracting, this was part of the division of learning. It was done by teachers and school, and parents rarely, or were very marginally involved. All of a sudden the parents are being bombarded by software. So parents are having to make decisions in an area where there weren't any decisions to make in the past. And parents are not necessarily in the position to make those decisions in an informed and thoughtful way.

People sometimes debate whether the computer is as big a change as printing. I don't know how to measure, because three year olds usually didn't read, and even if they did learn a little bit of reading they didn't read books. They didn't do research with encyclopedias and pursue their interests. So writing, printing, really didn't touch the very youngest children. For the first time we've got to take knowledge that can really enter into the real core of human development in the real beginnings, which is where it's happening here, and that's awesome and scary. If it's awesome and scary, the response can be that it's bad, let's talk about something else. It's not going to be solved that way. It's awesome and scary, but let's do something about it and take it seriously.

DKA: In the project-orientated education such as you are describing, how do you motivate kids to be sure that they are really learning rather than just entertaining themselves or doing something repetitive and not making progress?

SP: First of all I think this is an illusion that school is very good at motivating kids. Some kids are motivated, most are not. School can motivate them to score good on the test, but everybody, including the teachers know that you can pass the test and two weeks later remember nothing about it. You need a more intrinsic motivation to learn.

If we make comparisons between schools and what happens in real project-based learning, although in both cases you see some cases where kids don't seem to be working, I think in the examples we have seen in project-directed learning, many more kids are more deeply motivated than what happens in school. What's more important is that as we learn to make more and more varied kinds of project areas, more and more kids get grabbed because every kid is passionately interested in something. Every human being is. This seems to be something that is really an innate part of the curiosity instinct, or the learning instinct. All very small children, you see very few who are not motivated to learn, or they wouldn't. Children get along perfectly well knowing10 words to say I am hungry, they are developing their language, they are finding their way around.

So a lot of our work has been expanding the range of intellectually rich kinds of activities. Making a video game is an example of how to catch some kids. Composing a multi-media show with lots of music and sound and sights, can attract kids. Building robot out of Lego motors and computers, will interest another group of kids. Using these same little computers we use in the Lego and putting them in your pocket and attach sensors to your body so as you run around and jump and leap and play and throw things, it's recording everything that happened to you, and you can go home and sort of replay it, and that's something else that might touch kids who might be interested in math.

Kids are already into athletics, if they can do a kind of athletic, physiology and make it part of their thinking about it, and own perfecting of their skills and performance. There is just no end. Making movies, everyone likes to watch movies. In the past we didn't have the ability to do that in schools, getting the video cameras, the editing software, which allows kids to make artistic decisions. Now, we're beginning to have the technology, that's been harder. Now it's beginning to take place where with the technology you can express yourself in making movies or making music and putting them together as well as you can by talking and telling stories. So the range is just endless.

Another way in which we turn the traditional educational perspective upside down is even in the use of the word motivation. In school, the teacher decides that these 30 human beings are going to be doing such-and-such, and that's an outrageous, crazy idea that you can get 30 human beings, just because you said so, to become enthusiastic about doing something that is not meaningful for the lives. So you have a serious problem with motivating. How do you get them to do it? That transforms totaling when you're not getting the children to do something, you're offering them the means to do things that they think are exciting.

One of my favorite stories about kids and Logo is about a group of first graders, and it was told to me by a teacher. There was a first grade class that was writing to go in for the first time into this new Logo room, and as the kids came out that had just finished, the teacher overheard one kid ask another, "What was it like?" And the answer was, "It's fun. It's hard. It's LOGO." And I thought, hard, fun. Since then I have been listening and I have found this very common in children's thinking and in their language, that's hard and it's fun, not in spite of it being hard, but because of it being hard. The video game makers know this amazing fact that has escaped the educators somehow, that the reward for winning to get a harder task. And when you win that, you get an even harder task, and kids love it. This idea that we should make school easy is just upside down. Kids are not learning because it's too hard, but because it is just plain boring.

I don't think there's a so-called motivation problem. There might be some exceptional kids where there is such a problem, and there I think that in the rare cases where there may be psychological or neurological problem. With the majority of kids, there is no such thing as a motivation problem if you have them doing the things that they want to do, and if we can make these things exciting.

DKA: Is teamwork an important part of your model, and what does that look like?

SP: I see a team here, a team of people making this interview. There are some things you just can't do without a team. I think kids know that too. This happens with these technologies, situations come up where you need a bunch of people. That's very different from artificially creating a group of people and saying, you work together because it's good for you to work together. So teamwork where it's the natural way to do something, because there are specialized aspects and people should do them. In some of my best projects, the most interesting for me and other people, is that the intellectual work has been collaborative. I have written collaborative books, created labs. I don't think I could have done it alone, or it would have been very different anyway. And I see it with kids. When they do something wonderful with the computer they want to show it to others and share it, and very often another kid gets an idea and says, hey, can you do this, and the two are off doing it together. We see this all the time.

The idea of the computer as an isolating thing is totally false. It's true you see the isolated person withdrawing from society, but invariably, that's somebody who had social problems to begin with. So if a child uses the computer as the means to withdraw from social interaction, and for one reason or another that child was afraid of it, didn't want to get involved in a group, or whatever the psychological roots were, but it wasn't the computer that caused it.

DKA: One of the things that is fascinating in your work with computers is that in your teaching you have not restricted yourself just to the computer, but you have used computers to experiment with physical things. I am thinking in particular about your experiments with Legos, and even with artificial robots. How important will this connection between computer technology and other aspects of learning in the physical world in the future?

SP: In the real world, the idea of the computer that is this hybrid between the typewriter and television, that sits on the desk, that is just one manifestation of computer. There are computers all over the place. Every car has now got many computers. Marvin Minsky once shocked an audience in 1970 or earlier. Someone asked him, "Do you mean to say that every house will have a computer?" His answer was, "Every doorknob will have a computer." We are rapidly getting to that point. In this building there are students that are doing research projects in which the computers are welded into their clothing. Computers are just everywhere. This narrowing the use of computers for children to the PC is just absurd.

One of the very first thing I do with young children is with what we called the turtle. Now it's usually an abstract thing on the screen, but the early turtle was a physical thing that sat on the floor and it moved around, and the children used the computer to control its movements. So the computer was a way of controlling complex behaviors and it had sensors, so this was a way of measuring and observing them. It's a way of relating to the world in more dimensions than you had before. I think that's its essence.

So confining it to the PC in the usual sense is absurd. Anyone who sees it as that you can't say is a computer-literate person. He knows only a narrow sense of the computer. So just the excitement, the richness of the idea of having many things you can do with the computer, we should spread them as widely as possible. Obviously I think that learning has a lot to do with learning about the physical world, learning about how things work, especially maybe how they don't work. Building a complex mechanism is a wonderful experience in how to carry you through a kind of project that things will never work the way you think they will because you're only making an approximation. And friction and things breaking down because they are too heavy, and how to make structures, all of this becomes part of the learning.

So I see fundamental error in this idea that the computer takes people away from the physical world and puts them into a virtual world of the screen. It doesn't have to do that. The computer can enrich and give many more dimensions to a child's relationship with and understanding of the physical world, the whole physical world, and the social world, and the artistic world. So it should be part of that whole rich web of connections between anything and everything.

DKA: You have described a very different way of approaching education that in many ways would fundamentally change educational structures. What's the process to get there? Do you have a sense of the steps? Is it experiments in various places that then lead to fundamental change, how do you see society adopting some of your ideas?

SP: You know it's just about 100 years since John Dewey, who is one of my heroes, said about school and education many of the things that I am saying now. Basically he came out with philosophical ideas of how it should be done, and philosophical ideas never work powerfully enough to really shift a social institution as deeply rooted as a school, it just doesn't work.

I think we are in a very different situation now. One of the big differences is kid power, that is, there are a billion kids in the world. In America there are 50-million children, of these 50-million children, most of them didn't get much experience with computers, but for the first time, a very substantial portion of the ones that go to school, are getting experience with computers, and will continue to get it outside of school. I don't think these kids will sit still for the traditional third-grade curriculum. Already we see kids are restive, and are rejecting the idea, they don't believe in it. The more this happens the more it won't work. The more parents who bring pressure for change, or that take kids out. I don't know how the balance will work. I think a lot of parents will have to take a lot of kids out of school, which is already happening, before school feels the pressure that it will need to change.

What gives me a lot of hope that school could change is first of all, I know that there are very many teachers, it's a minority, but a large one, of teachers who know they can do something much better than school allows them to. They would love to have the opportunity to do things in a better way.

We talk a lot about having school demand more of kids. I think it's the other way around. We're beginning to see kids demand more of school, and what's most interesting is these kids who are demanding something better, because they have known something better outside, also have the technical expertise to bring that into the classroom.

As these computer-proficient kids flood into the classrooms as they are beginning to do, the lack of technical knowledge among the teachers ceases to be an obstacle. The kids who come in with a demand for better learning, also come with a new supply of technical expertise that could make that possible. And I don't just mean working computer, the research methodology for example, the kid who is used to getting in there and knows how to get into that Web and go after information. This is a kid who is a researcher and knows the technique of research and brings these into the classroom. I think we've got the conditions that could make a real, powerful force for change like we have never seen before.

DA: That is a perfect place to end this. Thank you so much for your valuable time and insights. This was a wonderful interview.