PROJECT-BASED LEARNING

Seymour Papert: Project-Based Learning

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An expert on children and computing, ***Dr. Seymour Papert*** **(http://www.papert.org/)** is a mathematician and one of the early pioneers of Artificial Intelligence. He is a distinguished professor at the Massachusetts Institute of Technology and author of major books on children and learning. Here he describes learning environments in which children collaborate around meaningful projects and powerful ideas.

1. On the powerful impact of project-based work.

During the last couple of years, I've been working in what's been one of the most moving and instructive educational experiences that I've had in my whole career. And this is working inside a state juvenile correctional facility, where children from age twelve upwards who've been sent there by courts -- they've done what would be considered a serious crime if it had been done by an adult. ... The governor of Maine, Angus King, who is a very progressive, forward-looking person, encouraged me to create a little project -- made it possible to create a little project where with just ten kids, we took them out of the regular school and they spent their time -- five hours a day -- doing project-based

work.

We used computers, we used MicroWorlds Logo, we used Legos. Some of them built airplanes, some of them built guitars. They worked on projects. And everybody who saw this was staggered at the difference of the energy that they showed there -- the kind of involvement, engagement -- compared with the lethargic, rebellious attitude in the classes. I think that this project that we could set up allowed some of them to get a new sense of themselves as learners -- that learning is something valuable, that setting yourself a goal and working to achieve it is something which some of them have never seen before in their lives. They've never known anybody who works over time for the achievement of some goal. So you can change their view of life.

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2. On what must change in schools to better accommodate project-based learning.

Well, first thing you have to do is to give up the idea of curriculum. Curriculum meaning you have to learn this on a given day. Replace it by a system where you learn this where you need it. So that means we're going to put kids in a position where they're going to use the knowledge that they're getting. So what I try to do is to develop kinds of activities that are rich in scientific, mathematical, and other contents like managerial skills and project skills, and which mesh with interests that particular kids might have.

If, for example, this Lego stuff is why a lot of kids love building robotic kinds of things and programming -- and they love doing that -- and you can connect that work to all the powerful ideas that are important for kids to know. So I imagine the learning environment of the future as we've given up the idea of there being curriculum that says you have to learn this at the seventh of May in your eighth year. We've given up the age segregation which is just as, I think, wrong and harmful as any other kind of segregation. It's just as bad to segregate the seven-year-olds from the eight-year-olds, the eight-year-olds from the nine-year-olds, as it was to segregate people by color, religion, or whatever. That will go away. Kids will work in communities of common interest on rich projects that will connect with powerful ideas.

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3. On how computer technology connects students' interests with powerful ideas.

Now with the computer, somebody whose interest is in graphic arts can use mathematics as an instrument to produce shapes and forms and motions on a computer screen. Somebody who's interested in music can make digital musical instruments, and so right along the line, we have infinitely greater ways of connecting the particular interests that an individual human being might have -- and a kid particularly -- with the powerful ideas. And so they really can learn

knowledge by using it, and that's radically different from school, where you learn knowledge which you are not going to use. Maybe never, or maybe even if you are going to use it in twelve years' time, even granting that what they learn is going to be useful one day. That's not a good way to learn. The good way to learn is to use it now.

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4. On what assessment should look like in a project-oriented classroom or school.

We should be measuring, of course. But we should be measuring different things. We should be measuring the diversity. We should be measuring how schools are changing. We should be measuring what kids can do with knowledge, not how many right answers they can give to questions.

So, I've been working, in fact, with people in testing. In fact, in the last year I've been a "visiting distinguished scholar" they call me, at the College Board, which is the organization that creates and supervises these tests. And I'm working with some people there on a concept of where you would incorporate your assessment into the carrying out of projects. So we'll assess kids by what they do. Now this is not totally original. The idea of using portfolios and being able to have something other than a multiple choice/right-wrong question as a way of assessment is around. A lot of work's been done on it. And I think fundamentally that's right.

Where I think it's weak, though, in the way it's being practiced is that they're still trying to test within the framework of traditional curriculum. And I think there's almost a contradiction in that because what was chosen to be put in the curriculum was chosen because it's the sort of stuff that is best tested by right and wrong answers. It's the sort of stuff that fits in with a pencil-and-paper kind of epistemology. And pencil-and-paper knowledge technology lends itself to right answer/wrong answer rather than something dynamic where you do things. So, as I see it, the trend towards portfolio-based, so-called authentic assessment is very good, but it's very limited unless it goes with throwing out the content of what we're testing.

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5. On the need to reinvent mathematics instruction in schools.

If you know the history, this is the way that mathematics happened: It started not as this beautiful, pure product of the abstract mind. It started as a way of thinking about controlling the waters of the Nile, building the Pyramids, sailing a ship. It started as mathematical thinking, just edging into real activities, what was really being used. And then, gradually, it got richer and richer and finally the jewel of the human mind -- I'm a mathematician, I really think that it is the jewel of the human mind -- gets broken off as pure mathematics.

In school, we reverse that process. We start off teaching pure math. Nothing is more pure in abstract mathematics than the stuff we teach in elementary schools. And it has to be if you're going to have such a thing as the "mathematics classroom." Because as soon as you have this other thing, it doesn't fit into a "mathematics classroom" or "mathematics lesson." I think we have to reverse this order of things -- that the order in which we teach mathematics and science today starts with the most abstract, the most static, and you learn to do manipulation of numbers, then you learn to do algebra, then you learn to do calculus, and at last you can apply it to something real.

I want to turn that around. We're going to start with applying it to something very real. So, I look for activities like -- here again, I'll use this example again -- it's just one of many, though: Building these robotic devices but putting mathematical principles into the way you build them. So that you're doing physics and mathematics and engineering and project design all in one go, but your content is not what is usually considered to be age-appropriate in that way.

My favorite example these days is the way we think about probability. Like everybody talks about introducing more probability into the school curriculum because obviously probabilistic thinking is important. But the way they introduce probability is some ridiculous calculating of fractions. It's not useful for anybody. You'd never suspect from that that probabilistic thinking was one of the most powerful and dramatic and far-reaching change agents in the history of science. You had made possible modern physics. It made possible social science. It made possible economics. It made it possible for us to understand evolution, which depends essentially on probability and randomness.

You'd never suspect that this is a truly powerful idea from the way it's taught in school. It's been disempowered. It's been disempowered because you couldn't give kids any way of using it. Now we can. We can have five-year-old kids making art on the computer, introduce randomness and probability into that to produce wonderful effects. We're going to have seven- or eight-year-old kids making robotic devices that have a probabilistic element built into them so that they can get around obstacles in the way that, if you look at any simple creature -- such as a fly -- it has randomness in its behavior, and this is how it avoids being trapped. We've got the technology to be able to have kids solve for themselves the kind of problem that nature solved using randomness. But of course, that doesn't fit into the second-grade curriculum, so we don't do it. Or we reduce probability to some little spinner and see how often the number six comes up. Who cares how often six comes up? You can't do anything with it.

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6. On the importance of teachers learning alongside students.

What we need is kinds of activity in the classroom where the teacher is learning at the same time as the kids and with the kids. Unless you do that, you'll never get out of the bind of what the teachers can do is limited by what they were taught to do when they went to school. And I think that's possible, and it's a different concept of what kind of

educational kind of materials and activities should go into the school. It's in line with what I was saying before -- that we mustn't think only of, "Is this to be judged by what the kids learn?" We've got to say, "Judge it by what the whole system learns, and that includes the teacher."

The teacher's got to be learning at the same time. And then with this robotics stuff, it's an example because ... every situation is unique. It's never been there before. And that's very different from the classroom situation where we're teaching math fractions. We've been there before. The teacher is not learning anything because the teacher knows that already. And this is a very bad situation for learning.

Again, one of my favorite little analogies: If I wanted to become a better carpenter, I'd go find a good carpenter, and I'll work with this carpenter on doing carpentry or making things. And that's how I'll get to be a better carpenter. So if I want to be a better learner, I'll go find somebody who's a good learner and with this person do some learning. But this is the opposite of what we do in our schools. We don't allow the teacher to do any learning. We don't allow the kids to have the experience of learning with the teacher because that's incompatible with the concept of the curriculum where what is being taught is what's already known.

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7. On reconciling dreams about the future with the reality of today's classrooms.

I used to be tormented by an almost schizophrenic conflict between one me that thought about the future, how things would be one day, what it would be like for kids who grow up with access to knowledge and technology and are fluent in the use of all this from the beginning. They're not going to sit still for anything like what we try to teach them in schools today. But we're going to have to work very hard to make the stuff that they're going to learn. It's not going to come about just by teaching the old stuff in a more, quote "constructivist" way. We have to work very hard.

So I've spent a lot of time doing that, trying to invent the kind of mathematics that they might be learning. But then when I talk to teachers and practical educators about this, they often find it inspiring, but then they come down to Earth and they say, "But what will I do Monday?" -- which is teachers' jargon for, "Be real: I don't have those kids. I've got thirty kids there. They didn't have computers or some of them did and some didn't, and I'm restrained in all sorts of ways." So then I'd give up the dreaming, and for a while I'd concentrate on making activities for kids, teachers to do, they could use now. But then I'd realize, no ... this is like being in a boat without a rudder. Unless we know where we're going, it's no good just trying to improve the system making incremental improvements. So I'd switch back into the other one. And it took me a long time to realize that's not the way to think. The way to think is, "What can I do Monday that will prepare for one day?" And this leads to a different kind of criteria for what you would choose.

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8. On the role that vision plays in producing real change.

Well, I think it's wonderful to show educators the best things that are being done. But we'll never produce real change unless we put considerable effort into what isn't being done. To creating visions -- visions of what it could be in ten years' time, things that cannot be done today. As long as we're restricted in our thinking to what is being done, we're like a boat without a rudder. We need to be thinking and putting serious resources in.

I think we need to do serious hard work in producing alternative models without being tied down to what can be implemented in the short run. I think if we take industries like aircraft, or any big industry, they are spending large resources on planning for the day when they know that what's cutting-edge today is going to be obsolete. The education world has to learn to put a fraction of its resources into what cannot be done today, but can be, but which can stand there as experimenting, as working with visions of a possible future.

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