Children, Computing and Creativity

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🔊[0:00]

Thank you for the warm introduction.

Thank you for your hospitality.

I'm indeed Gray Stager.

I've had a unique career that is taken me all over the world.

Almost 30 years ago, I began working with kids and teachers trying to help them make sense of a world in which computers existed for us too.

Expand learning opportunities; I was an elementary school teacher.

I've taught everything from pre-school for the doctoral level.

21 years ago, I led professional development at the first schools in a world every kid had a laptop computer that was back in 1990 in Australia.

And in 1997 I created one of the first on-line master's degree programs.

So I've taught on-line.

I've taught with lots of computers.

I've worked with gifted and talented children and my doctoral research was based on creating a high-tech alternative school inside of prison for teenagers in the United States.

So I've worked with all kinds of populations of kids.

And I've spoken at conferences in written and taught and consulted in schools all over the world.

So I'm currently here in Korea for the third time working with a new international

school in Song-do.

I'm called Chadwick international and It depending on who you ask, why I admire, you make it a different answer.

I view everything is interconnected so I find myself complaining about library books or playing with children or talking about room decorations as much as I talk about using IT or ICT.

But as best I can tell the school in Song-do is the first school in the world where every kids has a laptop down to first grade.

Over the 21 years that I've been working in schools where kids have laptops typically they'll be given to children at the fifth, sixth, seventh grade.

Sort of them sweet spot.

And it didn't require much imagination to wonder what kids would do with a computer when they're twelve years old.

They typically do what the teacher tells to do.

They do school work with it.

I've always thought as a much more interesting question and proposition to explore what would happen to very young children had their own personal computer that they could curl up with like a book or a stuffed animal or a toy.

And so as far as I know the school that I'm working with in Song-do is the first school where every child for first 8th grade has a laptop.

And they have the same laptop.

We didn't take an approach of little children get baby computers and big children get bigger computers.

🔊[03:04]

And so that's interesting but I'm also trying to just help the school function and create spaces and time for children to really achieve their potential.

One of the things that I'm fighting in schools in the United States and other countries as well, that certainly the case here is the school day is so chopped up.

So divided.

The kids don't have any time to think.

There aren't any time to work on and anything of substance.

There are time to the day I walk around the school, I can't even find the children.

Because they're always going here and there.

And then we have the nerve to say that there's a something wrong with the kids or they can't focus that they have attention deficit disorder or they're hyperactive.

Well, we never let them do anything long enough to get good at it or to be proud of what they do.

So I'm trying to make in general make school a better place for children to learn.

So, although you have a paper handout, there's a handout on the web.

And you can have Mr.

Google translated for you even.

That has a collection of resources and Anal links and articles that I've written about a variety of topics.

You can also type your e-mail address in there.

And receive a very occasional news letter.

I just finished the summer 2009 edition.

So you don't have to worry about getting too much mail from me.

But it's a way to keep in touch.

Skip that quickly.

Now I had the great fortune of working with Seymour Papert for 20 years.

The gentleman who, Jean Piaget, wanted to understand how children learn mathematics he hired Dr.

Papert and in mid-1960s, Papert started talking about a computer for every child as being less intellectual laboratory and vehicle for self-expression.

A place where you could play with ideas and where you can make things that you could have possibly made anywhere else.

And any says in this quote, the phrase "technology and education" usually means inventing new gadgets to teach the same old stuff in a thinly distinguished version of

the same old way.

Moreover, If the gadget are computers the same old teaching becomes incredibly more expensive and biased towards its dumbest parts namely the kind of role learning in which measurable results could be obtained by treating the children like Pigeons in a Skinner Box.

And Papert said that in an article called "Teaching children thinking" that was published in 1971.

And I'm trying to decide if I should get in trouble right now or I should wait a little while.

🔊[05:54]

But I suspect that these are sort of example of what he's talking about there of treating children as people who give you right or wrong answers and the role of a teacher is to catch kids being wrong as a opposed to helping kid correct themselves from the inside.

So my view of computers is to increase the opportunities available for children.

These were pictures we took a year ago right after the school opened when the kids got their computers.

These were 1st graders.

I'll tell you a funny story maybe you can help me understand this a little better.

For some reason, 1st graders thought it was a moral weakness to use a protective bag for their laptops.

They refused to use a bag.

I don't know if it was Korean children or just 1st grade children or 1st grade Korean children.

But there was a real fight they didn't wanna use a bag.

And so the teachers had this brilliant idea they said you should hold a laptop like a teddy bear.

Like this.

Which on day 1, cause three of them hit the ground and break the screens.

We haven't broken any screen since.

But that happened day 1.

It was just funny to see these kids wandering around with.

They all have bags that just prefer not to use them.

But I say on this slide that school is a technology.

And I think this is a really important idea.

You know, a lot of time, people say, "Well, why should we change school just because we have computers?" Well, because school has always been governed by the existing technology of the day.

Paper and pencil and slay and text books and desks and rectangular buildings with chairs in rows.

That was technology what previous era.

If one we think that in an era where kids have access to all this other digital computational technology that they're ought to be requisite changes in the nature of schooling.

For no other reason, that it builds upon the fluency the ingenuity, the imagination that kids already had.

So if you think of school as a technology, it has constraints.

It has cost and benefits or consequences and rewards.

And we have to think about in the future why is it the kids come to school.

Did they come to school so they can do this?

Could they do that from somewhere else, maybe?

You know, maybe school is the place where you come to be in a new orchestra.

And to work in the science lab and to build a submarine, or to do the things to be in a play.

Come together to do the things where you gain benefit from being in a same space at the same time.

And maybe the other stuff you can either go away or can be distributed outside the school space.

One of the ideas that's really guided my work for the last year until when I'm currently writing a book around this theme.

It's the idea that young people have a remarkable capacity for intensity.

I go a lot of schools where just sort of sleepy and sad.

when we know kids already like that, and I think that you can keep the energy level up a little bit, more learning will occur.

🔊[09:07]

The students will be happier.

They'll be more engaged and we know that if kids were given time to play to explore come of with a thousand examples they will spend countless hours working on something that matters to them.

What we know that the best learning occurs through things like hobbies you lose track of time or as you got better of something.

You wanna keep improving cause it is important to you.

And this is a photograph I took around 1991 or 1992 in Australia.

And I love this photograph because the kids were using laptops that were programming in a version of logo called "Logo-rider" at that time.

And in the time that between the kid hitting a return key.

And the result the period in his laptops screen.

Every ounce of him, every cell in his body were shaking in anticipation of the result.

Everything else is in focus, this kid is shaking cause he's so excited about what he's doing and hoping that is his hypothesis pays off that what he communicated to the computer will reward him.

Because if he's successful to be motivated and challenged to test the larger hypothesis or given him a bigger challenge or improve his working someway.

If it doesn't work, then he engages some debugging process it's not like getting a red mark on a piece of paper.

This matters.

I was talking to some teachers today and I was saying the only 2 grades you really need to give her A and incomplete either it's done or you haven't finished yet.

And when kids are working on stuff that matters to them outside of school, we're reminded about capacity for intensity schools need to build upon it.

Otherwise it manifest itself as misbehavior as bored them as acting out.

I mentioned a little while earlier that I spent three years working in a prison for teenagers.

Every single one of them has been told that they were stupid, that they had a learning disability or 50 learning disabilities that they're unconfident that their thinking was dangerous.

And three years we didn't have a single kid who had to leave the classroom for discipline reasons.

Behavior reasons.

Not a one.

I could go to any school and anywhere else in the world and find that on a regular basis.

Because the kids were working on stuff that matter to them because we put their needs and interests and passions and curiosity, a head of some list of stuff that was created by some committee somewhere.

You know, I'm not surprised when kids do extraordinary things when kids do great things.

I'm surprised when adults are surprised their kids are capable of doing great things.

You know, all the most extraordinary things in the school in Song-do we were talking early, all the kids speak English.

I don't know how this happened.

They speak English really well from the babies on up.

Almost every one of them plays a musical instrument.

They have an ability to do great things and we should be reminded of it.

🔊[12:02]

Some people are excited that we can use computers to teach what we've always wanted kids to learn.

Maybe with greater efficiency or efficacy or stickiness or comprehension.

But what really excites me is the fact that we can use computers to learn and do things that were just possibly just a couple of years ago.

And I'm gonna share some examples of children and teachers doing things that a couple of years ago.

No one dreamed we could actually be doing in classrooms.

So all of my work is guided by this idea of building upon children's intensity of children working on long term personally meaningful projects the idea of personal computing.

The 'P' in PC means it's yours.

That's a really big hard issue for adults to cope with.

And the things don't have to be the way that they are.

In all the work that I do, I tried to be guided by respect for the learner have kids doing authentic problems with real tools try looking for ways to do things that we wouldn't be able to do otherwise.

I believe that learning is natural.

If you don't believe that learning is natural, then you have to come up with all sorts of tricks to get kids to do things they don't wanna do.

I increasingly think that collegiality is important that there's a relationship between the kids and the adults.

That's mutually beneficial.

That's respectful and supportive.

I don't know if this is the case in here Korea.

But In the United States I'm meeting an alarming number of teenagers who have never had a conversation with an adult.

They've been called names.

They've been ranked and labeled and sorted and graded.

They've been told what to do.

But they've never fix the car with an uncle or got fishing with a neighbor or taking a

cello lesson and the social implication of that really scare me.

Now we can talk about if America's beating Korea on some math test and Korea's beating America on math test or we are all afraid of Finland they are very scary.

But a generation of children who haven't had any interaction with adults really has some negative possibilities that I fear and so I think that there's an urgency to our work.

Michel computers have been in schools in countries like this for thirty years that's a generation and a half and we are still trying to find ways to trick the teachers and touching the stuff um I think that's time to it's time to move forward.

A computer scientist, Danny Hill says "The computer is an imagination machine which starts with the ideas we put into it and takes them farther than we could have taken them on our own.

🔊[15:03]

If amplifies human potential, it allows us experiment that modification and for hypothesis it allows express ourselves in ways that wouldn't be possible otherwise and I think it's the responsibility of each educator to maximize the potential of kids.

Let me show this for minute or couple of minutes I found this video on Youtube recently.

This is a young lady name Sylvia she has a TV show on Youtube called 'Super Sylvia's awesome maker show'.

She's eight in this video American eight Korean nine I guess.

Um but she is anyway and she has the show where she teaches you how to do things so let's watch a couple of minutes of it because I think it really exemplify some of what I really talking about then that will share some examples of things that I'm doing with children in the spirit and I will pull out some lessons from it.

[Video Clip]

Welcome to 'Sylvia's super-awesome maker show episode 3'.

Before we get going, let's get moved this pesky black box.

That's better.

Today we ask two questions.

What do I do with my Arduino? If you haven't heard the Arduino's cool set blue open source pull out there and it's pretty cheap too.

We sell stuff on makershed.com/arduino.

You know you want some and you get one it's not always you should do.

I've heard of some people who get one and just leave it on a shelf.

What a waste!

When you're a beginner or you might be a control engineer there's two projects me and my dad came to take your brain go.

There are always nothing more than an Arduino and a computer since there's no reason next track.

Let's go.

For our first project, really making an adjustable strobe for this flash built, we will need an Arduino any kinds of it.

We will be using the dual twenty eight and a computer and a USB cable to upload to the Arduino and bright LED and I choose blue cause it's cool but you can use any color you want and finally a potentiometer if you have one.

You can make this without it but it is cooler with one.

First, take your Arduino and push the LED in compint thirteen and ground.

<Dah dah dah dah>Now it's time for 'Smart bot's thinking lab'.

Well we try to explain how things work.

🔊[18:02]

LEDs are light emitting diodes, are really just a diode that emit light.

Electricity will only flow through with it in one direction.

When electricity flows in the right direction, you get way.

You can tell the polarity of LED in two easy ways.

The long leg is called an anode, a positive lead.

<Hi~ that's equal.> The short leg is called a cathode, a negative lead.

This helps up to ground in our strobe.

Just remember negative short, positive long.

Easy-peasy! <Hello daddy~> If your LEDs have been cut off <Oh no>, they built in this cool little safety feature if it's flat parts here, that tells of that the lead on that side is a negative lead.

Thanks LED designers~ <Yah!> With the LED correctly placed all you have to do is tell the Arduino to pull the pin high and the LED lights up.

Do you know, LEDs are meant to be powered with about 2 or 4 volts and we will be giving this little guy?

This allows you to very carefully send a voltage between 0 and 5 volts to analog pin tip.

This value is read by the Arduino as number between 0 and 1,023.

Then using a little map this denver becomes the delay value for our strobe.Now we take the source code available at tn42.com/strobe upload it to the Arduino.

Now when our code is compiled and uploaded, we can experiment.

Here is one of my desk fans.

We removed the fan grill, so we can see it better.

Now we just turn on the Arduino and turn off the lights by turning the potentiometer.

It looks like it changes its speed of fan eventually slowing it down to a crawl.

It's really still moving pretty fast though.

So don't touch it! If you don't have a potentiometer, you can substitute any number you want for the analog-read-value in the code and it won't be easy to change but with some trial and error you can have it tuned in no time.

Call me and my dad maybe he is open to any number of adjustments a name, speed and output.

You can even understand and explain this as you guess the rpm of spinning object.

The possibilities go on and on.

Another favorite show project…Okay, so she's in third grade.

Now if she is just an actress, that's really good acting.

She is not just an actress.

She understands that stuff and I understand it better because she understands it so well.

And I wrote about this on my blog and what's funny is people find you.

So her father commented and she is just a regular public school kid who had an interest in this stuff.

🔊[20:58]

And he was concerned that there were not enough girl role models out there and that why should they just be consumers, why should they just buy things couldn't they make things as well.

And she has 100,000 of people who watch her shows regularly.

Um and this is something she does with her father for fun.

You know okay, now you are a third grade teacher, what do you do?

Because I can tell you now in a lot of places, when she gets the 7th grade, there is going to be a keyboarding class awaiting her or the curriculum will be 'where is the return key and where is the space bar?' Right?

Um she's been doing this when she's about three and it stuffed with the just that that shot here.

Right? That's two or three years worth of math that she was explaining that she was trying to figure out a way to change voltage based on the range of the sensor.

Um having that context of solving that problem is a much richer way of making that concept understandable than lots and lots of worksheets and what we consider practice where we never actually put it in a useful context.

That's kind of extreme she has other videos where she just as you know paint craft projects.

But, again it's sort of a really nice example of a young child demonstrating capacity for intensity.

And when we talk about educational computing, I almost never use the word ICT or ITA I know it's popular.

But I tell about computing as a verb.

It's something an action.

It's something we do as opposed to a noun.

I don't know if this is happening in Korea, but in the United States you hear politicians talk about learning as a noun.

That we have to increase the learning.

We have to get the learning to the children as if it some sort of disease that we just put it in a room with the virus and I'll get and I'll catch it.

Um…learning is something you do as the learner; it's some you do as a human.

And I think education computing isn't about Hardware, it's about Software and as because Software determines what you can do, and what you do determines what you learn.

Cause as PHA teaches us "Knowledge is a consequence of experience.

It's the result of experience.

It's not something as delivered to you." And in order to make this possible, ever serious about computing every child needs a computer.

Now, I know it's expensive except where it's not.

In 1990, when we got laptops for kids in Australia, they cost 3,000 dollars each.

And we told teachers that they couldn't work at the school anymore if they didn't buy their own.

Now, they cost a fraction of that and dropping rapidly over time.

That each child, if we want to be of use a computer and a transparent, casual way that they can where the kids can do what they need to do when they need to do it, then they need their own computer.

And they need their own computer with some open-ended creativity Software.

We knew early in the 1990s that giving the kids laptops was the right decision and it matter to the kids when this started happening.

🔊[24:09]

When they started writing their name on them and decorating them with stickers and glitter pen of things.

Because they had appropriated the instruments by which they made ideas but which they constructed knowledge.

If they own this thing, they own the stuff that they created in side of which is particularly ideas and work.

We didn't know how the world would change or will and provide every kids with a computer but we had an expectation and it could change everything.

And indeed it did change.

Curriculum changed, scheduling it changed teachers relationship with kids it changed class size, it changed furniture, it changed architecture.

All the sudden children needed to be mobile.

When I first arrived in Australia, the classrooms had benches, there were from one wall to the other wall and teacher needed to see a kid, they had to climb over the bench or you couldn't even get near another child.

That was important once kids working on projects and we needed to be work with them.

Now, I know some of you might be thinking 'Am I really suggesting every kids should have their own computer?'.

And when my friend and mentor see more paper used to get out this question.

He would often be a wise guy and say "No, I am suggesting that every kid should have two computers."

And I led some institute in the United States where we bring a lot of really smart people together with teachers.

And give teachers the luxury of 4 days to just make things.

And if we have time, I can show you some examples.

But, any idea is fine.

No experienc6e is necessary.

I had a history teacher, say "I would like to charge my iPhone while I ride bike to work.

I said "Great" and we wrote it on the wall.

And 4 days later, he was riding a bicycle through the hotel lobby charging his iPhone

with a generator made entirely out of lego.

There is no curriculum for this.

No one would write a curriculum for this if they did, so crazy.

But, it in fact work cause he had decided idea, yet he had to support the culture, he had the materials any at that time necessary to make that idea come to life.

And I just captured some images recently like these.

This is during my workshop.

These are young teachers from California who are using one, two, three computers.

One, two computer just sort of spontaneously because they are learning how to do something so they watch the tutorial or they are doing some research on their iPad and programming on the laptop.

If you watch kids with this stuff, you start seeing that they are using seeing the multiple screens.

Keeping them away from them is just a way of sort of crippling and reducing their potential.

You know I just took these photos last couple of days in SongDo.

I just wanted to go through some of them because it is completely different model of computing.

🔊[27:01]

These kids have built little models of a house.

We have a little circuit board.

This kid has in his hands called as a pico board and it allows you to connect to a computer and it allows you to make sensors, get feedback.

So you could flush the toilet and have your computer go 'pushhh' or have a doorbell or have lights turn on or something.

So they are using the stuff of a childhood with the new stuff of childhood with their computer.

And this is the first time ever used computer and kids were having positive results.

There is another one.

And they are doing more these other stuff.

What's really exciting now is once again there is an opportunity to do things with your hands that for people who are concerned about kids always being at a screen we now got this wonderful marriage or we can create really great stuff that requires the computer but also requires to use your hands and tools.

You know, look at this kid just operating spontaneously He is king of the world.

He is doing a school work.

He's got a notebook.

He's got a laptop he's got a book.

Next one, this kid, I took this morning.

This kid is just found his own place to work.

He's just decided He's wanna be interrupted or something.

He's sitting in the closet essentially.

These two girls were rehearsing a cooking show they are going to do for the class present.

They are going to present how to make some recipe.

So they are practicing.

I don't even know what they're doing.

But it involves two computers.

They had video being recorded and I'm one and the other was reminding what to do or something.

They just spontaneously around the school.

I took this from the stare way.

The kids are just sitting using their computers where they need them, when they need them.

This little kid, oh his feet! Oh, that's him.

All they are too big, all they are too heavy not to him.

I was calling him jiminy cricket.

He looks like.

He looks like he is from Pinocchio.

I think that exactly oranamic.

Here, when professor lee was here this morning.

The kids were making little plays with clay.

And they are using a camera in the laptop to film the motion of the video.

I can't believe what these kids manage to do with camera built into their laptop.

Real camera will be better.

But they just took to using what they have, you know, regular books.

You know, you know kids are working together.

This kid was working in programming some geometry with me.

I came up to me in the hall way as I was living in this afternoon.

To tell me, that he think he solved the problem at home last night.

🔊[30:03]

It wasn't an assignment.

It was an after school activity that we said anyone who wants come can and I asked him if he can program the computer to draw that and he came up to be today and said) I did it at home for fun.

If you ask the computer to draw this through instructions it pretty much cover more than I learned in 10th grades geometry class.

You know, there's a concern that if kids use computer, they are socially isolated and that's nonsense.

You could see in these photographs and anyone else's who ever worked with kids and computers knows that they tend to be more interactive, more social and that the social interaction in this research supported this social interactions are more work related.

Even if the kids are chatting during the class they are often saying "Have you seen this?" or "This is like what Garriott was saying" or "I don't understand can you help me understand it?"

And there are lot of studies that demonstrated that from children up though graduate school.

Because, why can't you talk in class? You can't talk in class because it is disruptive.

But if you could talk without making noise then it actually it may have positive benefit.

It's certainly better than that just passing the notes or punching the kids next you.

This is one more controversial things that I'm going to say because I know that Keris has an eye in it for information.

I think that information access represents the smallest piece of what I mean to be educated.

Education is about doing, looking stuff up you know, if the dominate metaphor for using the computer is to look stuff up, no one should be surprised when kids look upon inappropriate stuff.

But the looking stuff up is the least interest thing you can do on the computers.

Making a report is the least interesting thing you can do on the computers.

It's a lower hanging fruit everyone know that what you can do with the computers.

But Use it as a constructive media with which you can create all sorts of other projects really add values what's possible.

That doesn't mean that I'm like against using the web, I couldn't live without it.

I teach on it.

I get restaurant   recommendations.

I stay and touch with my friends.

But I think, I made this chart for people who like charts.

I think that if you are looking at return on investment.

Low return on investment, high return on investment, least learning, most learning, I think drill on practice, information access, productivity.

We've been billions of dollars teaching children how to use Microsoft Word as if it

takes more than 3 minutes of learn and result is, I don't know ten years of secretary.

You know, Simulation and modeling and then making things I think offers the greatest return on investment.

🔊[33:00]

We live in an age where there's a revolution taking place in what's called DIY America, DO IT YOURSELF which is different from HAP which is Hire a pro.

There is something that is changed in the culture where people want to make things again.

There is a magazine called 'Make magazine' that learn to make affair.

They run several of them in the United States.

A hundred thousand people come out on a weekend to share the inventions.

This is a desire to make stuff.

Reality tell and there's all kind of books that now support that idea of working with kids geek that or how toons or made by hands where you can work on a project with your children to make thinks with your studentBut we also have this phenomenon reality in television.

I don't know what you called it here, people are often horrified by it.

But I actually think that it's a positive trend because I think reality television recognize this desire for apprenticeship experiences in a time where there are a few apprenticeship experiences.

You know, I talked about young people are not working with adults.

Now if you want to learn how to dance or sing or build the shed, fix a bathroom, you, or you know, paint the picture or cook a soufflé.

There is someone on television.

You can apprentice with this.

Even if you are just wanna be a drunken loser, there is someone you can apprentice with on television.

You can watch experts do what it is and that they do.

I think it's really powerful and really exciting.

And we make a mistake if we dismiss it.

Technology matters because it allows kids to do things they won't powerful before, it allows for greater range of breath and depth of a project to exist that it ever existed before.

Because if we have this wide spread availability of computing material we can do what Piajet said which understand to invent or as Pepert said it make things with computers than we can make a lot more interesting things and the stuff that we can connect computers makes that 3 dimensional brings that into the world and allows us to answer question like why kids do with the computers in school.

I'm unapologetic advocate for computers in schools and I also tell you most of what I've see and done with them is bad.

Most of what I've seen and done with them underestimates kids' potential.

It's a waste of resource, waste of time, it tends to be travail.

It is misguided.

That doesn't mean that I wanna get computer at classroom when it's used them in more constructive and creative ways.

So look at some examples at the moment.

But it's based on this idea that making things is better than being pass it, better than sitting and yet making good thing is even better.

A lot of teachers afraid add it children work or say that could make better way? Do think about following? Why did you doing this way or that way?

🔊[36:00]

I've written an article about printing materials.

You know, every school, every primary school in the world has you know a week you asked kids go home and get their grandmothers recipes and each kid bring it the recipe and run them through the photo copy and you staple them and send them home.

Why can't you make a beautiful book? There is million and one ways how can you turn into something that kids and parent cherish.

It doesn't mean that every active project has to be that way is close to that way.

But why not have beauty has powerful contents creating something? Why not make the work matter? You know, as my inspiration,

Italy have shown that if the opera house needs a new curtain, why can the 4 year olds make it.

Why can't it be designed something to become part of community that matters, that indoors, that has a value, that people would be proud of.

When we think about using of computers in schools, we have to ask a question about agency.

By agency, I mean who has the power in the educational transaction.

And when computer is used in schools they tend to serve one of three people, one of three masters, the system, the teacher or the students.

They almost never serve more than one of those when you really look at it.

So you know when interacting with a white board is appropriate for a teacher, a system that tracts right answers or report in office somewhere of the system, and look the short example I am sharing for you is putting a learner at center of educational transaction.

As the person does the learning.

Skip this quickly.

So one of the ideas, that is really exciting that people at MIT and it's make a magazine and it's do itself community talking about is one the next revolutions in technology use.

It's a personal fabrication meaning, right now, if you want to watch, if you go on the web find a watch, give your credit card your information and few days later truck arrives when you get the watch.

Well, there're people who are working towards day went instead waiting for the watch to arrive you go on the web you find two or three watches you like take features of each.

You put them together and then print it watch on your desk.

And with razor cutters, water jet cutters and printable-circuit boards and such we were getting to a point where for what a computer costs in 1980s in a school.

You can have one of personal fabrication lab in a school.

I'm amazed the report I go to a number of the school has some of this equipment.

The other thing that I want to say about is when you look at Sylvia.

Is she an academic student? Is she a vocational student? Is she an art student? Is she a science student? She is all of them.

My daughter who was an art major one of the best liberal arts colleges in America was in charge of razor cutter.

A generation ago, the dumb kids what have gotten them it has certainly wanted to in the art studio It's now with clay and paper in the paint and the boundary between art and science and other disciplines and vocational verses academic are really blurred.

And I think we now, we can finally start treating students like we are going to educate them whatever eventuality comes before them.

So that regardless of what they've done in school they can make decision of oxford or plumber.

But we need to decide for them at 6th grade.

And this photos again in summer institute.

This is using what Sylvia is using this micro controller called 'Ardurino' it's open source micro control which means it's only close about 25$.

And people all of the world using them and adding to them and making better all the time.

A professor of MIT named Rio Viewcle has come up with version as she called 'Lily pad of Ardurino like lily pad, a pond and their wearable computers there are actually machine washable you can throw it in the wash so that this teacher are sawing computers the circuitry that have conductive thread.

Now when you think about this was science fiction.

We work really hard to get teachers to do things with children to work on a project use real materials.

And a lot of teachers are really proud that they bring in the bulbs and batteries and kids can connect bulb to battery and I don't know what is something.

You can do the bulb and battery stuff.

Now but you could also make your backpack detect and intrude a sound alarm.

Or you can make a T-shirt that has turn signals on the back on the you ride in the bike they turn signal on the traffic or when I ask teachers in my workshop to take off

teacher hat and put on their learner hat they decide to make a teacher and learner hat where when you throw a switch either a T-LED lights up.

And this picture they took the logo of school and put LEDs in it and programmed them in patterns so they would dance on the T-shirt.

These are the toys kids are working with now.

What is amazing about this like I said is, two years ago this was something we only read) about and it's now completely doable and again I think there's something really nice about sewing, you know it is fun to work in to class songdo and ask have any of you have sawn.

🔊[41:59]

You know, seeing how few hands had gone up.

It's bringing craft to science, technology engineering to mathematics and connecting the arts all that as well.

Let me share with you a little example of one of my favorite stories.

This is a 5-year- old.

So this is the little video that causes a lot of people to get really upset and question whether they're doing the right thing with their lives because this is a 5-year-old.

This 5-year-old was in a school in Australia.

It was a school that was in deep trouble school, failing school.

That was one of the reasons why I was working there.

Kids were poor.

There was a lot of disfunction home and the school but this little girl read like a champ at 5, she is really nice little kid.

I asked if I could have a class of multi age, mixed ability kids for 3 hours a day.

Why that I want multi aged kids.

First of all, school is the only place where you group people by their levels of incompetence or as Cirket Robinson recently said by their manufacturing date it doesn't happen where else in life.

Second of all, I knew that I multi aged heterogeneous kids that I already gathered with me for 3 hours at a time.

If a teacher walked by the room even just picked in a window they might want to come in and find out what was going on because it was so weird.

Because a lot of times I work at disfunctional schools no one cares what I am doing.

So, anyway, this 5 year old came to school one morning she was late for school, so she was upset, something bad happened at home.

I was trying to calm her down and get her back into class, reintegrated into the class and I also had a problem that I had given the laptop to some else to use.

Because there weren't their laptops so I brought them with me and I didn't want her notice that someone else is using her laptop I thought she would be more upset.

So I asked one of those really clever questions that middle aged Ph.Ds ask little girls.

I said "What do you want when you grow up?" And she said I want to be a ballerina, a very unique answer.

And I said "Well, did you take lessons or go to classes?" and she said "No I don't even have lessons or classes." And then I got myself in trouble.

I said "Well, you know, if you want to become good at something it's worth having some goals and working hard and studying formally towards the goals."

And then she got really mad at me and she pointed her finger at my face and she said, "Look School does not teach ballerina."

I thought very perceptive observation.

And I can tell you if I was the principal of that school I would have a ballet teacher there after lunch but I wasn't the principal at the school so the best I could do was suggest that she use her laptop and her microware software and the lego, we had, the rumbled lego and bring a ballerina to life.

And this video clip, this is like 2 minute video clip has about 10 lessons for teachers in it.

So let's see we can identify some of them.

[video clip] So the dress is a napkin and magic marker, the hair pipe cleaners, but look at this shot for a moment.

The camera is gonna zoom in and now watch the little girl.

🔊[46:00]

Now.

Okay.

So she has two sensors, one for left and one for right.

We would be happy traditionally if kids that age knew left from right.

She knows left from right.

She's also dealing with gearing and friction and sensors and programming and debugging and some art involved.

When I talked about multi-aged class rooms someone will say "Oh you mean like the older kids read to the younger kids or as we do that the older kids teach the younger kids."

And I say "Except when I goes in the other direction." and then he sees that shot, there's that she's mentoring someone who's twice her age and three times her mass and volume because the little kid know how big kids find valuable.

And it is also funny where the principal says and acts condescending voice "And you did this with your computer" As it, you know, she's amazed that kid is capable of doing anything.

That's what 5 year old is capable of doing.

That's the first time she use the materials.

And I started thinking over time, how's it possible that a kid can do that, a 5 years old having never seen the materials before in a couple of days or a full school day.

And I developed a teaching theory that I called a good prompt is worth thousands words and that says if you have a good challenge or idea, prompt, appropriate materials, sufficient time and a supportive culture that includes expertise you can solve problems much bigger than yourself.

Because I've been wondering for years how was that I run 6 hours workshop kids or teachers will leave having produce something more complex than if they work through 2-year curriculum.

How was…

Is it because I am magic? I am really lazy.

I don't do a lot there.

You know, I had 40 kids from 2 different schools I've never met before.

Also it wasn't a lot me doing the work for them.

It was helping them follow ideas and asking a good questions every so often and keep being there to help if they asked for it.

You know, we can, kids can make their own video games as supposed to be consumers of them.

When they programmed their own video games they are learning about the geometry and physics and graphic arts and writing a narration and doing voice over and composing music and doing all the sorts of the elements that require a great deal of intellectual and creative effort in order to create something that's there and something they value.

So we have engineering opportunity.

This is another video.

I shot this last November in Songdo.

This was the first we, the kids had their laptops.

We were using a robotic construction called Pico-cricket, very similar to the lego.

And I gave these kids a challenge.

I said there's a starting line on the table and there's a finish line.

🔊[49:01]

Just put 2 pieces of tape.

Push the button it should stop at the finish line.

And to make it tough I told them that they can only try it three times on the course.

So they had to do some

So this is the result.

[Video clip]

So now I have a video of the third year engineering course of MIT doing that.

If I went to Europe best engineering school, they would be 20 years old doing that.

If 8 years old are doing that, the second or third morning that they've use materials,

imagine what they can do at 20.

Imagine that math and science that they now have reason to learn because it's useful to them.

Because it makes sense.

Because it's their idea to learn it.

I'm thinking about doing a challenge before I leave.

Tell me if this is too mean that you build a vehicle that, it has to move.

But when we come in the morning it's still on the table.

Because most of the kids will fall off and break it in million of pieces and I think it's kinda mean but it's also kind of funny and it's whole different kind of engineering challenge.

You know, it's that a playing with simulations where you're not sure why your neighborhood burn down or why you starve.

What if you take a history class, the computer says build the simulation of a life of middle ages and you can control the number of plots and lands you have and workers and the seeds you are planting and then randomly levels of rainfall, plague, castellan, taxation occur and then you find out whether you live or die in middle age and this case it says you have died in the middle age and your family is starving, the world wants more than you can pay off with your head, drops and rockus kill your crops.

Now you go back and change some values and save you survived.

Now in the best classrooms you get a simulation and you let the kids play with it.

But there's magic behind it.

You don't understand the causality.

If the kids build it themselves they have much deeper understanding of and they are using mathematics in this case, they bring some sort of historical phenomenon into a life.

You know, we could use software like this, geometer sketchpad which allows a teacher to teach geometry with the all same way that they have for centuries or you can ask kids make their own and if you tell them how to drop two points on the screen and find the distance between them they can make a segment, the can make a segment of mid-point, they can make mid-point, they can find the area.

And as they learn more geometry, their tools get some more sophisticated and as their tools get some more sophisticated, they learn more geometry.

So we have this ecological approach.

🔊[52:00]

That as you make something, you learn more, as you learn more, what you've built has become more sophisticated.

And it also sends the message that you have the intellectual power and control to solve your own problems.

This video, it's one the last examples, I saw two more examples that we have a conversation.

This video was created by a 15-year-old inside a prison for teens.

This kid walked into our classroom one day we had a population of students they came and went regularly, you never knew how long you can have a kid for.

They created interesting challenges and each kids have been told that they were defective, that they were dangerous, that their thinking was bad, that they were stupid.

And yet, this kid walked into our class and said I want to do something hard, something nobody has ever done before.

Wow, that's interesting.

And he knew that I was safe thing to ask because he knew that in our classroom he could do things like that, that we would put his interests and needs, a head of some list of stuff.

Because the governor, the government at that time recognized that if you have ever 15 or 16 years old kids failed over and over and over again, doing the same thing one more time isn't going to change their results.

So maybe we need to change everything so this kid decided to work on a project which came from just the list of ideas that I had.

One of them was built the phonograph.

[Video clip] So let's take the part for a minute.

This kid essentially was Edison.

He reinvented the phonograph because if we are 15 years old today you probably

never seen phonograph.

Second of all, he was one kid holding a camera and another kid talking.

This wasn't that a TV studio.

The kids were using units and his sentences.

He was talking about revolutions per minute and talking about levels of magnification and he one taught kids gun to their heads to use the unit in the sentence.

🔊 **[54:58]**

No one told him to look at the grooves under a microscope but we had a microscope so he thought it was interesting.

None of this was assigned.

If we had said make a phonograph and has to have three of this, four of them, two of the other thing.

That's all he has done.

He went way beyond what we have expected of kids like this.

Because it was his idea and because it was interesting to him.

And we often see in these videos misconceptions that revealed they would never identify it pencil and paper where kid is having trouble understanding some concept.

Now let's look at a completely different domain.

I was teaching teachers and I teach this course with kind of weird way where I said to them there's no test, there's no work graded it's online class every week there's new learning adventure.

I liked the word learning adventure and I said to the students I am not gonna tell you what they are advanced because if you knew what some of them were, you drop the class you would go to psychiatrist.

You would hire a tutor I want you to have the experience I want you to see what you can do work with your colleagues think about their thinking think about your thinking reflected on the experience so one of my favorite ones to do is to tell them to download the piece of software like and compose a piece of music.

The great thing about teaching on-line is that when you ask adult to compose music you can hear them scream because this is something they think they can't possibly do because they've never done it before hmm but computer makes it possible so I

had one student who said to me I said how did you compose the music he said moves the balls and sticks around until I got something that sounded good.

I said just like Mozart hmm you know music theory is how you describe the movement of balls and sticks but how you can move the balls and sticks around you can make music one student asked themselves a question I wonder if I can puts note on the score at random so he googled random music and he found out about serial music and it led him to Michenburge and he went to a concert and he bought a CD made all this connections have never made before.

Some students will hear each other's work to be inspired to try something else.

They would ask each other for help.

They would join communities on-line ask for help and they would read documentation but at the end of five or six days every single teacher I've work with can compose piece of music.

So as did the young really good English teacher as..

as one of my students she was one of those teachers you must have them here who coaches sports, raises five kids, gets out of the 4 o'clock in the morning, goes to the gym, does the master degree in her spare time, you know, lifts weight I don't' know she's like a super hero and she walked into our English class next day and said you would never believe it.

My crazy professor wants me to compose music and kids kind of giggled and she said, "You know what that mean?"

🔊[58:00]

"No, what means Smith?"

"That means you compose music."

And the kid all started to screaming like the adults and she said, "No, I think you can do it you could work together you can use the tools I think you can compose music and if it was peculiar because it was in English class."

So one of them said "What should the music be about?"

And she hadn't even thought about it.

Until this point and she said "Well how about lady Macbeth?" [Music Playing]Now like the other examples I shared with you these kids had had very little experience.

Some play instruments, some read the music, some never had at all.

And yet the computer allowed them to go further that you could have gone on their own.

That for the first time in history, music is something that you can compose something you can do.

Now just recipient or consumer of and you would be really hard herded and wrong to suggest that if you spend three class periods in English doing that you are wasting time because I think the kid, the kids are thinking about Lady Macbeth in a whole different kind of deeper way from different angle from another perspective through different side of lenses and all of the work that I've share with you as I start to bring this to close so we can have conversation I find that any school that I have privilege of working and any teacher I have the opportunity to work with and the audiences I have the..

[Bell ringing]

That was a bad idea.

That was my timer.

Any audiences I have luxury of speaking to I'd like to leave them with four words and that is less us more them.

🔊**[61:58]**

Anytime you are ready to intervene on behalf of some educational transaction as an adult, as a parent, as a teacher, You should take a deep breath pause and ask yourself "Is there a way I can give more agency to the learner?", "Is there a way where they can do less, they can do more and I can do less?" and that manifest itself in every level of what I do in education.

I'm gonna share one last example because sometime people wonder about "Well, where is this lead?"

And "Will the kids be able to get a job?"

And "Will they be able to compete against Finland or Singapore?" and I'm gonna tell you the story about Tony.

Tony was 17 years old when I met him.

He was this tall.

This was in the prison where I worked.

He was wearing an orange jump suit like a one piece orange suit which meant he tried to escape.

And I thought what a perfect school uniform.

Maybe we should put all the children in the orange jump suit.

And he told me that he hadn't been a school since he was 12.

None of his peer group, none of his friends were in the school since they were 12 years older or younger and yet in our classroom he fell in love with photography.

And Tony was building cameras and he can talk ,excuse me, and he talks about F stuffs, aperture and depth of the field with the great deal of sophistication.

He had plans in his note book to build the hot air balloon.

That it went up in the air with taking a real photo when an ice cube melted and release the shutter on the camera.

And when I asked him if you thought that it would work he was furious with me for questioning it.

And said he tested all the pieces he just never had chance to let it fly.

We thought Tony was leaving us the next day.

So I was interviewing him for my research.

He turned out to stay couple of extra weeks with us which allows for this project to take place and he had told me that since he'd be in this environment where it has own computer where at the freedom to work on things that matter to him.

That he was viewing the world differently.

We had one kid.

I called him Michael.

Michael had been institutionalized.

He had been taken care by the states since he was 7.

Everything in his permanent record, his pile of paper said he couldn't read and write.

He was illiterate.

Now we had a lot of evidence this wasn't true like he was programming computers, and even install software, and if he had to he read the manual.

But we never made a big deal about it.

A couple of days before he turned 18 years old when he was gonna be thrown out of the street.

He said that in his computer he's typing a lot he was working really hard he wasn't being interrupted he wasn't interrupting anybody else he was working and our only rule in the classroom was you have to be doing something.

So he thought that was something it looked like something to us.

◀ᴗ[63:55]

After several days of typing he hit the print button on his computer walked over the printer pulled out that much paper handed it to us.

And in it was a 13,000 words autobiography.

And when we said "Hey Michael, we were told you, you couldn't read and write." he said "Oh I could read and write.

I just wasn't a strong reader and I didn't like reading about puppies." And he sort of mumbled and walked away and said "I like to read about NASA." so somewhere around first grade some teacher told him to sit down shut up and read the puppy story.

And he said "I'll show you." And for the next 11 years he was locked in some barrel where he was never going to show an adult that he could read and write.

And yet if we had MIT scientist come down he could talk about material science or engineering with the level of comfort that most adults didn't have.

He could built 25 mechanisms in the time that would take us start one.

And yet his entire part of school experience had been based on him not letting on that he was confident.

So Tony was very similar and he told me that since he's in this class room where we allow him to be himself.

We had technology we can amplifies his potential where there was a lot of time to work on things to matter and where we are support him.

In his project, he said he was viewing the world differently.

I said how so.

He said well.

You know it's spring time and there holes all over the campus.

It's ground hog's holes.

Where there's anil leaf and normally I wouldn't give them a second thought but now I wanna know what's down there.

And a little help from me.

And more help from my credit card.

We bought different size of cameras, lights, and 30 foot USB cable.

Because at that time we couldn't get good enough wireless camera that would send information out of hole.

And he never learned much about what was down the hole.

Just like sometimes NASA scientists don't convert Farenheit to Celcius and their probe blows up or burns up.

And if you didn't anticipate twig in the hole you might lose couple days of the work or one day the ground hog actually popped out of the hole behind him and delved into their working in and the kids are pretty much peed on their pants they are so scared of it.

But this is him talking about the experience.[Video Clip]

🔊[67:01]

So imagine if the high school graduation exam was that if you see a hole on the ground or the heaven above or sees ahead or you wonder about the natural man-made wonders around you that you have the confidence and the competence to begin to answer some of those questions for yourself.

Even if only to learn this problem is (a) lot harder that I thought it was and I need to learn more stuff in order to solve that problem.

That's what the most severally damaged that risk kids of capable of doing and I think this is kind of experience of all kids need.

One of the famous of journalist in American in 1958 said this guy named Edward R Murrow he was speaking to a convention of television and radio executives and he said this instrument can teach, it can illuminate; yes, and it can even inspire.

But it can do so only to the extent that humans are determined to use it to those ends.

Otherwise it's merely wires and lights in a box.

Another way of saying that there's lot of computers in schools and not a lot of computing.

It's combined upon all of us.

To lift our game to build upon remarkable capacity for intensity that children have and to use the things that part of the world in a ways that enable him to go further it could have gone on their own and with that.

Thanks you for your time and patient and happy to have conversation of anything you wanna talk about Thanks folks.