**Dr. Chris Dede**

**Kansas State University College of Education   
2014 Distinguished Educational Research Lecture**

Good morning. It is my pleasure to welcome you to the second annual college of education distinguished educational researcher lecture. I'm Debbie Mercer and I serve as the dean of the college of education. We began last year with the inaugural visit by Dr. Gloria Ladson‑Billings. We're thrilled to continue the tradition of highlighting research that profoundly impacts our profession.

It is my pleasure to introduce you to the work of Chris Dede at the Harvard graduate school of education. Emerging technology, policy and leadership, with special interest in the role of new information technologies and knowledge creation, sharing, and learning. He's received multiple grants from the national science foundation and the Gates Foundation that provided funded for his research on immersive simulations. Dr. Dede and others designed and implemented the river city project. A curriculum based on multi virtual user environments that allows students to function as scientists seeking a cure for an epidemic in an online world. Two new awards have the goal of developing a science curriculum and the study of how technology can be used. Dr. Dede and his research team are study the effective information games. Students must use higher order thinking skills to tackle complex environmental and public health issues. His team is teaching educators how to create similar gains for use in their own classrooms. Our distinguished speakers recent books include digital teaching platforms online professional development for teachers emerging models and methods and scaling up success, lessons learned from technology based education improvement

Dr. Dede serves on many advisory boards and a member of the international steering community in education study that includes 30 participating countries. Dr. Dede was a fellow of the American education research association in 2011, and was bestowed the honor of outstanding teacher in 2011 by Harvard university. I firmly believe technology is changing education faster than ever before. I look at my own granddaughters and the technology that they use in their everyday life, and I can actually see the impact of technology on how they think and learn. So this topic could not be timelier as they are in classrooms right now for which we are preparing educators. I would like to take a moment to recognize Dr. Rosemary Talab, she has put in countless hours. Rosemary, I thank you very much for your leadership, and I would like to recognize the rest of the committee.

They have done a fabulous job and thought through how could we really use technology to enhance the activities that are going on on campus. So we have people zooming in from all across our state, from other regions, universities, we have people at the state department in Topeka that are zooming in. A lot of them are across campus. Education distance students to participate in this lecture and others scheduled for this afternoon. The presentation is also being live-captioned. That was very important to us as we reach out for a live variety of people.

Please join me in giving a very warm, wildcat welcome to Dr. Chris Dede, the Timothy E. Wirth professor of learning technologies. I appreciate you making the time this morning for me to share ideas, as a faculty member myself, I know how busy we all are, and it is great to have so many people here, I'm looking forward even more to the interactive sessions this afternoon when we get to dialogue more. But I can assure you that although we have until 11:00, I have absolutely no intention of talking that long. I will break the talk into three chunks, and after each chunk, we'll have the opportunity for some questions and dialogue at that point. So I'm going to jump right in. We live in a really interesting time because information and communication technologies are doing three things at once. They are changing the kinds of knowledge and skills that society wants from our graduates. I have the dubious distinction of holding an endowed chair at Harvard in a field in which I've had one course in my life. That course was in 1967, it was FORTRAN for those of you who know computer languages, boy, I use that every day and it was on punch cards. I hated that course so much, it drove me out of the field for the next 8 years, until apple released what at the time was the microcomputer. And then I gradually morphed from a science educator who used technology to somebody who studies learning and teaching through the lens of technology. But that story isn't unusual for those of us in this room. Many of us wear shoes now for which we weren't fully trained for our academic presentation, and it is absolutely the story for our kids and our students growing up in a world of not just multiple jobs but multiple careers, and many of those careers do not exist now. So asking how we prepare students for careers that don't yet exist is a really interesting challenge. The same technologies that are creating that challenge are giving us new ways of teaching and learning to meet that. And I want to spend the majority of my time today discussing that. But I also want to note that they are changing the nature of learners themselves. I teach my graduate students at Harvard different than I did 3 years ago. Because of what they do outside of the classroom for entertainment, for personal expression, for communication and that in turn shapes their learning strengths and preferences and I need to adjust to that. So I want to show you a video. I try to be a 21st century kind of guy. So I have a 45 second version of my talk for those of you who like, you know, quick overviews of things. You have to watch closely, because 45 seconds goes by fast.

In fact, it takes longer to load.

[Laughter]

[Video]

So it is interesting to look at that video, and sometimes people look at it and they say, wow, look at what technology can do, isn't it marvelous how technology energizes those students, I don't think it is the technology at all, because I've been in plenty of classrooms loaded with technology that were incredibly dull. The reason those students are excited is because they are doing active learning with their friends, not because they are using technology. And in fact, one of the most important things to say is that unfortunately learning technologies are not like fire, fire is a fabulous technology, because just by standing near it, you get a benefit from it. I watch people put technology in the classrooms and stand near the monitors and wait for knowledge and learning to radiate out into their minds and of course nothing happens. Because learning technology are much more like clothes, you have to put them on, you have to have them tailored to your need and their value is as a catalyst, so when technology is used for deeper content, more active forms of learning, or authentic forms of assessment, links between classroom and life, it is a value, otherwise not so much.

But I don't want to start by talking about technology, because then you have a solution looking for a problem, which is never a good thing. So instead, I want to start with a report that came out about 2 years ago from the national research council about education for life and work in the 21st century. This is a available for free from the national research council website in PDF form, it is not that long, I urge you to read it and I'm trying to incentivize you're reading it, because fundamentally it is about why a really good education in 1995 is now not a good education for what we're facing in the world. And that's primarily because we have moved from a national industrial economy to a global, knowledge‑based, innovation centered economy. And the two are quite different. Now, the report is interesting because it breaks these knowledge and skills into three categories, cognitive, intrapersonal, which is things like being flexible or having an appreciation for diversity, and interpersonal, which is things like collaboration or leadership, or solving the problems that groups can get themselves into. And the reason that it does this, is because there's a lot of research that shows now the 10 years after you graduate, you're intrapersonal skills and interpersonal skills have more to do with your success in life than your cognitive knowledge and skills. That doesn't mean that all three aren't important. But it means that in the 21st century in particular, where so much work is done by teams, including teams across distance, where people never meet, that those intrapersonal, and interpersonal dimensions are incredibly important.

I'm kind of notorious in the Ed school at Harvard because I asked the dean if it was possible to put low maintenance into a job description. It turns out that that's illegal. We all know what that means, we all have colleagues, that however smart they are on cognitive, they really struggle on intra or interpersonal communications. I excerpted some of the skills and put them into columns reflecting the different kinds of backgrounds. What the report says and I agree with it. At the end of an educational experience. I don't mean at the end of a session like this morning or at the end of even a single course, when you get your degree or certificate, you should have a footprint that enhances all of these aspects of yourself so that you can function effectively in life and work when you leave. And it is instructive and a little sobering to look at that footprint and ask ourselves where does most of the emphasis go and where does almost no emphasis go? There are cells that typically we give a lot of attention to, and there are other cells that students largely are left to develop on their own, which means some do and some don't.

If we ask what we assess, the picture is even more dismal, because what we assess using the limited assessment skills is a smaller subset. It is what the institutional is held accountable for on society. So there's a real mismatch now between what our objectives out to be and what we're doing. Everywhere, including Harvard.

So that's a big problem, and I find myself thinking about my own graduate students, masters and doctoral and asking myself, how well am I do and how well are my colleagues doing in terms of the footprint. I've thought about this not only in terms of Harvard, but across a variety of settings, including of course K‑12 education. The programs that do the best recognize three kinds of contexts which take place. They work very hard in order to maximize the impact of the institution on all three of those contexts. One of them of course is the classroom context, that's where we put most of our time and energy. But a second one is these rich experiences in the real world that helps students learn things that we can't possibly do even in the best classroom. In our program, living in Boston, which is a great place for this, we have a lot of internships and apprenticeships and field experiences that we arrange for students that help us to reach that dimension. But it is not easy to create those, even in a rich setting like Boston, and not every setting has those kinds of advantages, especially at scale, if you talk about every student having some kind of rich, real world learning. I'm going to come back to this theme later and talk about the role of technology and some creative ways that it might help us to accomplish that.

The third dimension, and this is interesting as well, is this idea that learning communities now are really a context in themselves. They are not a physical environment, but people are spending so much time on social media, that there's a blended context in which sometimes you're interacting face to face, sometimes across distance that you might not ever meet, also how to transfer ideas out of your context into a different context.

So when I look back at that footprint, and I ask myself, how do we really cover these cells? I don't see a way to do it unless we've got three out of three. You can pick two, or unfortunately, sometimes we pick one, just the classroom, can't do very well, with all three, I think we can get traction. So this is a talk about how we use technology to try to get to those three. But it is also a talk that tries to build on what we know about teaching and learning, because as I said earlier, technology has no value in and of itself, unless it is a way of taking something powerful we know about teaching and learning. And of course, one of the most popular publications that the national research council produced that came out now about 15 years ago was their book about how people learn. And that is a long volume, also available for free. But one way of boiling it down is that they talk about four different dimensions of learning, and any really powerful learning experience they argue has to incorporate all four of these dimensions at the same time. It is not either/or, it is cumulative. So it has to be centered on the learner, what they care about, what misconceptions they have, the curriculum and the structure and the knowledge of skills that you're trying to teach, what mastery looks like, it has to be centered on assess. Not necessarily assessment in the limited sense that we think about now, but diagnostic assessment that's formative for instruction, I'm going to talk about technology and more later on and overarching those three is this idea of community. You're part of a community that's making sense of things together and that brings in this idea of the third context.

So this kind of design is really quite complicated. This illustrates why instructional design now is much more complex than it used to be. Because the more we understand learning, the more we understand that we really need to be thinking about all four of these don't he mentions at the same time. Notice I'm not using the word technology. This is not something that applies to technology‑based learning specifically, this is something that apply in general whether or not you're using technology or not. There's a huge body of research to back this up.

Where I ended up in my own thinking walking down this path, is a grand challenge, which is why do we make 3 times 4 equal 19. Those of you who know mathematics, not even necessarily higher mathematics are looking a bit puzzled because 3 times 4 doesn't ordinarily equal 19. We've got three contexts and four dimensions of learning and 19 types of knowledge and skills that are important for the 21st century, along cognitive, personal and intrapersonal dimensions. We got to make 3 times 4 equal 19 for our students, somehow, collectively across the experiences we provide within higher education and that's the fundamental aspiration that we face that's really quite different than what excellence used to mean when we were preparing students for a different kind of world.

So the rest of my talk is going to illustrate how I think about ways to try to meet this challenge, and where there are some technologies that look as if they are interesting levers that we could use to move in this direction. And it is kind of awkward to talk about three and four and 19, so a kind of code that people seem to use right now is to say that learning should be personalized. I was part of a conference in 2010 that came out with a report on personalized learning, I was part of a conference about 6 months ago that's going to produce a report, but in many ways if you look at this definition of personalized learning, it captures the idea of context, independent, it gets into the emotional and social dimensions as well as the intellectual dimension. When I say personalized learning, I'm trying to evoke this larger construct of 3 times 4 equals 19.

So with that, I want to sketch three things and hopefully be able to stop and talk after each one of them so we've got the chance for a dialogue, even in a lecture setting. The first one is how we personalize. Personalize meaning how do we tailor something for individuals when we're teaching in a group setting. I'm like you, I have a lot of students in my courses. In format like this, obviously, we can't really personalize to an individual, not doing what I am doing now which is lecturing. Are there ways that technology that can help us to personalize even within the constraints that we have within the university environment? Well, a colleague, John Richards and I wrote a book that came out in 2012 called digital teaching platforms, that takes the classroom as one of the contexts and how can you customize learning for each student when you're working in a group setting. This describes the evolution of the kind of technology that isn't here yet, but people are moving alone different paths to get to the same center, and digital teaching platforms is what we chose to call it, you may have your own term that you want to use, but the concept looks something like this.

A digital teaching platform needs eight kinds of things, and one of the things that we can do, if we look at the typical classroom, over time, is to notice that whether we're talking precollege, or post secondary, classrooms, more and more classrooms are having more and more of these things. So in hearing what's happening in the school of education here, I hear about Kindles and iPads. I hear about moving from a print‑based curriculum. I hear about using different kind of tools. I guess zoom would be an example. And differentiating curriculum content, and thinking about diagnostic assessments.

So over time, we're gradually getting the pieces that we need to put this particular elephant together. Some of you are saying this stuff has been around forever. I've heard about management systems since the 1980s, in fact they are over hyped and don't deliver very much. Which is true. They have been over hyped and do not deliver very much and the reason they put technology at the center. Technology isn't a good thing to put at the center, because technology doesn't work very well as a vehicle for making sophisticated instructional decisions about students' progress particularly on the intra and interpersonal dimensions. When technology doesn't have an intra or interpersonal dimension.

They say, yes, there are technologies and they can be semi autonomous, kinds of like the sorcerer's apprentice, but the teacher sits on top of the suite of technologies and the teacher is the one that's making the instructional decisions and the teacher and the technology together are working to customize. We go through platforms, largely pre‑college, to look at the kinds of ways that either face to face classroom, or an online classroom becomes different when the teacher is able to stay in charge but differentiate the curriculum by sub dividing the instructional task between teacher and technology.

The book walks true a whole set of research advances that are needed to make digital teaching platforms commonplace rather than something we are moving towards or some people are pretty close to and other people don't much have. In the work that I'm doing now with the visiting expert at the national science foundation, I'm trying to help them see how they might prioritize their investments to make this kind of infrastructure come true.

So that's all very general, and, you know, it is hard to understand what that might really mean. So I want to give an example of something that's probably not the kind of thing that's coming to your mind when I sketch this container of a digital teaching platform, and you imagine within your own field, what might fit inside of that container. Because you're probably imagining the stuff that most of us have spend much of our time doing historically, and that's not really the most interesting opportunity. So earlier I talked about this issue of how do we give students rich, real world experiences at scale, even if you're in a location where there aren't that many opportunities to give students rich real world experiences, or if you're K‑12 where student aren't really able to go outside of the school building very often, in order to do this. For the last 20 plus years, I've been studying the psychological phenomenon called immersion. We have all experienced immersion. You go to the movies, maybe you watch the Hobbit, and after about 5 minutes, psychologically, you're no longer aware that you're in a movie theater, even though that's definitely where your body is located. Psychologically you're in middle earth with Gandalf and Bilbo. That's made possible because of a whole variety of things that movies doing, high quality acting a compelling plot. Immersion isn't new. Really good books can introduce immersion, but we study strong forms of immersion. Books and movies are weak forms because they are passive. You're just an observer, we develop and study strong forms of immersion that provide the opportunity for people to shape the environment that they are immersed in. Today what I want to show you is two of those forms, one the multi‑user virtual environment, which is like the Alice in wonderland interface. And the one that's a little like the terminator, a robot that walks through the real world and has magic eyes and can see an overlay on top of the real world. So in a minute, I'm going to show you a video that illustrates multi-user virtual environments as a kind of immersion that can help us provide these rich, real world experiences. I want you to imagine being in the middle of the winter and you want your students to be ecosystem scientists in the middle of a rich ecosystem. Let's say it is a pond ecosystem. You don't have in he way to do that in the real world, unless you use technology and immersion. That's a project called EcoMUVE, and I want to show you a little bit of what EcoMUVE looks like.

[Movie playing].

They use mostly virtual environments to teach middle school students about causal patterns. Two computer based programs within an ecosystems curriculum. We can walk around the pond and see all of different plants and animals. The camera tool let's us take pictures and saving the photo displays information about each of the organisms we find. We can walk under the water to see the species living there.

Using a virtual micro submarine we can shrink down and see different levels of magnification. Environment around the pond includes features like a golf course roads and houses. Following this pipe leads us to a drainage ditch where we meet a landscaper putting down fertilizer. Throughout the environment on different days, you meet virtual characters like Manny who may provide useful information. Back at the pond the water measurement tools let us take various measurements of the pond. The calendar tool let's us travel through time to see how it has changed on different days. Here it is raining. When we walk under the water, we can see how cloudy the water. We can also take another measurement.

The data view let's us see and compare data that we have collected. The atom tracker tool, we can find and track three atoms, carbon, phosphorous and oxygen, we can find the atom tracker signs and read a description of what has happened. We see part of a water molecule on the leaf of a tree. On our next visit, we see through photosynthesis the oxygen atom is being released into the air as part of an O2 molecule. Students work in teams in order to figure out what killed the fish. Once the students have collected all of the data, they can use the graphing tool to compare different variables to help them creates concept maps that explain why the fish died. Within the simulated environment, students develop a richer understanding of complex causal relationships in ecosystems.

[Video concluded].

I'm going to stop there, there's more available on the Internet about this particular project, and I know of course you're thinking, wait a minute, this is middle school students and this is ecosystem science, what does this have to do with me. Think of this as a container. This is a container of these multi user virtual environments in which many things can go. The ecosystem scientists who helped us develop this who you will meet in a later video this morning, felt she could have benefitted from something like this in her graduate work in ecosystem science if it had designed more detailed. Think of it as a simulator and students sitting in a classroom can be immersed in something that gives them a simulated real world internship, that's not the same as doing it the real world, but a lot better than what the teacher by waving their hands can try to accomplish. This is team‑based because inquiry is typically now done in science. They rotate role. There's a lot of other design issues be behind this that we can go into this afternoon if you're interested or not. But the other piece that makes this fit into a digital teaching platform, remember that's where I started is the digital teaching platform. It collects a very rich diagnostic trail of data. Because this is a virtually world, we know second by second exactly what each student is doing. Where they are going, what they are collecting or not collecting, what they are saying and storing with their teammates and so on. It is not very easy to interpret those log files, in fact it is hellishly difficult. You have to take small decisions that students are making and aggregate them, cluster them, filter them, have skilled people try to help interpret what that means, in terms of what students know and don't know and what they need next, and then develop rubrics that let the computer score it. So once the skilled person has figured it out, the computer is capable in near realtime of sorting out what this means and how to help the student get to the next level. This is the heart of the digital teaching platform. No matter what the student is doing in the electronic curriculum, whether that's some kind of problem set, whether that's reading, whether that's writing, whether that's creating something or experiencing immersion in a virtual world. There's this data trail that's being collected that's the basement for diagnostic assessment that's formative for instruction.

Now I was part of a national research council report in 2001 called "knowing what students know". It was a follow‑up to how people learn. This was a vision of what people knew back then. You remember when stores used to close for inventory. Most of you know what that was like. You go to a store, you're all set to buy something and there's this annoying sign on the door that says, sorry, closed for inventory, come back in 3 days. You never see that anymore because of the bar code reader. Stores know second by second what their inventory is, other than shoplifting and that's the goal for where we need to be for assessment in education. Not drive-by snapshot assessments every once in a while that tell us too late what students know and don't know. But constantly taking inventory and creating very rich learning trajectories to help us understand students, that's the heart of what make the digital teaching platform effective. Virtual worlds are a wonderful medium for not only immersion but for intentionally being able to do that. Our students used this curriculum for about a month that they do both modules. At the ends of that month, between the outcome measures like the concept maps and the process data, from this diagnostic engine, we're pretty good at understanding what they do and don't know about at ecosystem science or about inquiry, or about complex causality.

We don't really know, yet, how good they are at collaborating, or leadership, or self‑efficacy or meta cognition, which are part of that 19. But that's a dosage problem, because if we have 6 months' worth of that data, I think we probably could draw some conclusions about some of this. So this is not just an engine for narrow cognitive skills, this is potentially an engine for something much broader and something more powerful than that.

I want to stop at this point and throw it open for questions and comments, and let me remind you of where we have been so far. I've claimed that perhaps the biggest challenge that we face over the next couple of decades is this issue of preparing people for a world very different than what we grew up in, I have argued that one dimension of that is personalization and how we work in group settings to individualized and to provide diagnostic feedback, I've thrown out the idea that there's an engine being developed, an infrastructure called digital teaching platforms, and the most interesting thing and the thing that's farthest behind is thinking outside of the box and putting in different experiences of these other contexts that are really important.

So questions, comments, issues that you want to raise at this point? Yes.

>> I think it is a fabulous notion to do the immersion. I teach students to work with disabilities, how does an individual professor do this?

>> They can actually start on their own. It is harder to imagine how you would start with a virtual world on your own. Based on our experience at this point, I think if somebody said to us, why don't you add a desert ecosystem, let's say, we could do that for $50,000 and 4‑person months. Not something that an individual is going to do. Frankly not something that a university department would necessarily want to do, but if somebody did it and you could amortize that over millions of college students, it would be dirt cheap. It is the situation with these virtual worlds. There are some arguments that I and others are making about how that might happen in part through the private sector and public/private partnerships, in part through building the graduate school version first and then the other versions by taking stuff out and simplifying it. Here is a bunch of stuff that's coming, it is going to be shaping the next 10 years, in the way that social media has shaped the last 10 years. Start thinking about it, because the biggest missing piece is the individual faculty when the containers are readily available.

>> I hope the microphone works. Chris, I grew up in Chicago, and my very first mediated learning experience was with the public TV station in Chicago having a camera on top of a chemistry course and it was black and white. And we all watched it. I'm less concerned about the technology issue than I am about the student issue. And I guess the question I want to ask you is, how can we help our students move to a point that they are not driven by things like urgency, I get e‑mails every day, as many of us do, that expect a response in 5 minutes. Like we all should be sitting at our computers and I don't think that's the best way to learn. But I don't know how to help our students and I teach graduate students, doctoral students, experienced practitioners, how do we help them come to chill out and look at the learning in a broader way? I am clueless, and I would be interested if you could at least provide a suggestion or two from your work.

>> Sure, I'll sketch a quick answer to what is a very complicated question, and certainly one that I confront in my own teaching. I think that students often view the goal as the credential. They are making a bargain where they will give us tuition and they get a credential. When the world is reinventing itself every 10 years or so, the really powerful things we can give them are those 19 things, the credential fact is relatively worthless if what you have credentialed is obsolete within 10 years. But they are not going to take our word for that. The question is, how do we help make the experience authentic enough so they see it does relate to the real world that they will be moving into when they graduate and engaging enough so that they find it pleasurable and worthwhile and willing to be less urgent because they actually feel they are getting something out of it. I don't have a complete answer to that question, but I think these kinds of media that represent near transfer between the real world and what they are learning in the classroom, as opposed to far transfer between what you're writing on the blackboard in the real world are a part of authenticity and these kind of experiences that really build on a whole set of dimensions and that involve figuring things out with your friends, which is of great interest to students of every age, that can help. Those are levers that can help us get out of that particular box.

I'm going to push on a little bit, because I'm watching the time and I want to give you the big picture briefing and we will have this afternoon to talk about some other things. So I want to show you the complement to what we worked on with eco move. And partly where this came from, I would go to ecosystem conference sciences and I would show them this and I would say isn't this wonderful. It is an ecosystem simulator that's immersive and authentic, they would get mad and say, Chris, our motto is no child left indoors, and you're building stuff where kids never have to go outside again, of course, that isn't what I was doing. It does get at this issue. We really need to make learning wide. Another hat that I wore, I was one of 15 people that worked to prepare the 2010 national educational plan. It makes it much more interesting because it uses technology. One of the things it started with is this classic graphic that shows that the fraction of time that we have students in classrooms and on campuses or school is minuscule compared to the fraction of their lives. If we want to accomplish those things, we got to make learning life wide. Around 10:30 there's the student and the teacher and the classroom, then there are these other sources of learning, they are learning from all of those sources, they are just not learning much academic, how do we infuse academically valuable things into the rest of life?

Well we have the engine that we need to do that already. We don't have to build a digital teaching platform, we have everything we need in terms of device and software right now. That's of course, the mobile devices.

Some of you might remember the original powerful mobile device for learning, the little professor calculator from Texas instruments 38 years ago, one of the great tragedies of my life is I now look like the little professor. I never thought I would get this old. Of course, our modern mobile devices are much more powerful than the little professor on a whole set of capacities. My friends within the hardware industry tell me within the next 10 years, we will gain as much power as we did on mobile devices as we did in the last 40. You have to picture everyone of our students, even students in poverty, coming into classrooms with the power of a supercomputer in their pocket.

>> How do we take advantage of that on these 19 skills?

>> Now some of that we already have the software for and that is social media. And like many of you, when I'm teaching, I look at the kinds of social media that are currently available, I ask myself to help figure things out together, for interpretation and transfer as something that would be useful, if it is, I find a way to use social media to do that.

>> We can talk about that more this afternoon as well.

>> Part of what I'm accomplishing when I do that. I'm also trying to inculcate what people call new literacy. Literacy means fundamental in the way that reading and mathematics is fundamental, so it is not a small thing to say there are new literacies, and yet if we look at the 21st century, there are things that we finds ourselves doing, not technical things but intellectual and psychosocial things that look like literacies. For example, we use distributed cognition. I did my income 6 months ago and I entered into a partnership with a tax preparation program. It did two kinds of thinking that I don't do well, manipulate numbers accurately, I did something that the program doesn't do very well, which is to make up creative excuses for the IRS, the two of us worked together in concert where the whole was more than the sum of the parts. As we prepare our students for the workplace, we see example after example of distributed cognition. Digital teaching platforms are distributed cognition. But the teacher has to understand the strengths of the tool. My younger daughter is 14, we adopted her from India. I still have a small child at home. She goes to the textbook, she goes to the encyclopedia, but she goes to Wikipedia, a punch of different websites, blogs, just like your students, she's finding multiple sources of information inconsistent, incomplete, some of them inaccurate, some of them bias, and she and her friends in their IM windows, talking to one another, using snap chat, have to decide out of this mishmash of stuff what they want to believe and why they believe it and why they find it credible. Those are literacies that certainly weren't as important as the time I grew up.

I confess, I don't believe in all of the new literacy. After hundreds of faculties meeting, I no longer believe in collective intelligence. I think we're starting to scratch the surface of social media and I want to show a video next that illustrates a very powerful source of social media, we have top down sources of knowledge, like us, our readings and our encyclopedia articles. Students have bottom‑up sources of knowledge like social media, perspective taking, and different cultural frameworks that they bring to bear. And the really interesting stuff happens at the intersection of top‑down knowledge and bottom up knowledge, to remind you of this, I want to show you a recent news story that illustrates it very well.

[Video playing]

>> Little pig, let us in. It is the police.

>> That little pig is now being taken into custody. The great area of homeowner's rights to protect their properties.

>> This isn't right.

>> Hardly constitutes reasonable force.

>> You can't protect yourself in your own home.

>> If someone tried to blow my house down, I would do the same thing.

>> He had asthma.

>> Inside job.

>> There's no reason why those two houses, one from straw, the other from wood should have collapsed. Not even a healthy puff should have brought them down.

>> Framing the wolf in an attempt to cover their tracks, their motive was financial, as they struggled to keep up with their mortgage payments.

>> Lost everything. [Video concluded]

>> Well, maybe it wasn't the news story, but isn't it interesting that the guardian, which is truly a great newspaper, equivalent of the New York Times created a video like this. Even newspapers like the guardian face going away, unless they find a way to justify their existence at a time when most people, for better or for worse, are getting most of their news and their perspective taking through social media. Whether deliberate or not, the video is actually very clever, I think, in illustrating this intersection between top‑down and bottom‑up. You have the compelling social interest bottom‑up, but the expertise and the new information coming in top‑down.

So as I think about where we're going with social media and teaching, I think we have many more dimensions to get into as we think about new literacies and we think about this new issue of epistemology the other thing they do is our project called eco mobile. Like the terminator, it moves through the real world but has magic eyes. What we're studying is what happens when you give people mobile devices that are designed to empower their thinking. So I want to show you a video that illustrates our work. Think about this as a container into which many different kinds of things for students of many ages can go.

[Video playing]

>> Eco mobile is a program we have been developing for middle school students that helps them connect with their learning in the classroom with the real world experience. They have been able to work in the classroom in their science class with a multi‑user virtual environment, they act like scientists to collect information in the virtual. Now that we have developed eco mobile, learning more about them in the real world. We have developed a game that students can play on Smartphones, using a 3G wireless network at a real pond. As the students move around the environment, they encounter hot spots. There's information that connects with what they were learning in the classroom. What's a producer, a decomposer? It allows them to take measurements. Students have been coming out with us to the pond environment and going on field trips and using their technology to connect with the classroom.

>> I see a lot of green and all of these plants and trees ‑‑

>> The kids have been very excited to use the Smartphone devices, it is amazing to see how quickly they can pick it up and use it to its full capacity. It took a short introduction for the kids to be able to navigate with the device and to access these hot spots, they were figuring things out and troubleshooting together. It was fun to see them work together to solve some of the problems they were encountering and one student might not quite understand how it worked and another student was right there to help them figure out. Some of the probes they are using are very similar to what real scientists use. They realize that, and they see things about the water quality and start to understand what this means for ‑ you know, we've had a lot of rain in the last few days, they are connecting the fact that the rain might affect what's happening in the pond and their local environment. They are starting to under stand that the things that happen in the world are affecting things very close to their home.

>> The more cloudy and the lower the less cloudy.

>> I agree.

>> That was a good prediction, now let's see if you were right.

>> Can you get the bucket?

>> Yeah.

>> Got it.

>> Did you fill it up?

>> Yeah.

>> Is it lined up?

>> Let's see.

>> Channel 2. So it is the brown one.

>> It is going up.

>> So if we didn't have these phones, the students wouldn't have a good way to access some of the additional information that connects with the classroom. The experiences in the real world when we have gone on field trips before have been these one snapshot kinds of activities. When they go back to the classroom it is hard to remember why it matter. Now that we have the phones to connect the classroom with the real world, we can take the phones back to the classroom and use it to connect their learning.

>> We get to learning about the oxygen in this case, and we're answering questions and it is awesome. Much better than using a textbook, because you're in it. You can see everything instead of just reading.

>> Yeah.

>> The questions are relayed to what you can physically do, instead of just what you know from your knowledge. [Video concluded]

>> That's a little backgrounds about the augmented program. We can talk about that later if you like. 3 points I want to make about that. The first one is this is a container. Many different kinds of things can go in this container. If I were teaching economics, I would augment a mall and show the flow of goods and flow of materials and money, and people. If I were teaching history, I might augment a neighborhood and I would have students go up into people's attics and collect some of the old photos and digitize them and create the evolution over time. This is quite a new medium and we're just understanding how to interpret what they are seeing, under stand how an ecosystem scientist looks at a real ecosystem differently than somebody who is not an expert.

The second thing I want to point out, this also, like social media and virtual worlds generates diagnostic information. In our case what we have been doing, beyond what we collect on the phones, which gives us their path and a bunch of data about what they are doing. We strap GoPro cameras to their heads. They are devices that came out of the X gaming communities. They are terrific for data collection. You get HD video. You get sound that's good enough to pick up what the whole group is talking about. Now we have very rich diagnostic records of what students are doing, effectively in an internship experience. Again, understanding how to interpret those isn't easy. How to rapidly interpret large segments of video. The other points I wants to raise and it bears on issue that you brought up about virtual worlds, the thing we use to build augmented realities you can get on the play store or iStore for free. I could teach you in an hour how to make an augmented reality around this building. It is much easier than to think through the structural design of what a really powerful one is. This is technology that can be bottom‑up, at the end of the project release it locally and put a framework on top of that. Think about the augmented realities that might be useful in your field. It is tying into the community dimension and the real world dimension of the three contexts.

In fact, augmented reality contradicts something that we have been saying to students from millennia, you want to understand the world, you got to get away from the world. The world is chaotic and noisy, come to the forum with Socrates. Come to the industrial classroom at the school and we'll teach you about the world, and that's true, up to a point. The classroom is one of the three dimensions, but now we can say with augmented reality, when you're in the world, you'll have a device that knows who you are, where are you are, how you like to learn and who you like to learn with and how to reach them. That's very interesting. That's a very interesting way of thinking about those 19 skills. So that's the second chunk, the sort of complement to the flight simulator is the airplane with an embedded instructor inside of it. I want to throw it open for questions and comments before I go on and do the third chunk before 11:00. Yes.

>> So is this the same or does this fall within the same framework as adaptive learning, where there's sore of a component of artificial intelligence that goes in to assist with creating it more personalize and to adapt to that individual?

>> There was been a lot of work done on adaptive learning that's artificial intelligence driven. The group that's done the furthest in this is the Pittsburgh science of learning center, funded by the national science foundation, I was chair of their advisory board for a few years. It is very powerful, but very powerful only for a narrow range of subjects, people have been building intelligent tutors for 4 decades and for only a fraction of the curriculum. A fraction of the curriculum where there's a limited range of right answers and the right answers are well‑defined, so that a computer can make sense between right and wrong. So if you're teaching computer programming or teaching mathematics, or teaching the early stages of a foreign language, it works quite well. If you're teaching how to write effective essays or trying to creative production of any kind or trying to teach the kind of nuance, moral decision‑making that characterizes much of the social sciences, there the field diverges, people like me say you're never going to get there with AI and adaptive learning, you have to decide which side you want to believe. I think we'll have to move to media that's more human centered than technology centered if we're really going to be able to achieve this vision. Yeah.

>> Thank you. I think in some ways for some of us you're preaching to the choir. We are moving toward a more inclusive instructional model. We're moving toward a more digital model and I think that's a good thing. I would be interested though and maybe this afternoon you'll address this question, there's some practical realities of institutional life in higher education that drive us to do things that might not be the most instructionally effective, but meet administrative goals of generating revenue, generating student credit hours, all of that kind of practical stuff that we all have to live with, and I would be interested in you at least maybe talking about how the balance is achieved, between effective instruction in the year 2014 and the practical realities of living within our case, a state‑supported land grant university that has day‑to‑day challenges, that may fight against those very good principles you're talking about.

>> Sure and do I want to begin this afternoon. This afternoon is not going to be a lecture. This afternoon will be interactive and we're going to talk about what you want to talk about. I'm going to begin with the question you raise and in the higher education section framing the issue of disruption.

What happened to the railroads is interesting. The railroads dominating the transportation industry, but the problem was, they didn't think of themselves as being in the transportation industry. They got their lunch eaten by the car and the airplane as a result of that, because they didn't think in terms of what their real mission was. Higher education no longer was geographic anomalies because of distance learning. Every institution that I taught at before going to Harvard was state supported. One was fourth tier, one was third tier, one was second tier, they weren't research institutions, they were very similar to where you are. Harvard won't face a challenge because it has a particular brand. Parents send their kids to college for as much as who their roommate is going to be as for anything we do in the classroom. That's not the situation for most institutions. Most institutions are going to face what groups like Caplin is doing. Caplin is 100% on to a lot of this stuff, they have got a million student now. They are quite capable of operating at scale. They are making nice profits that fuel this. The fear that the ecosystem of higher education is going to change dramatically and be impoverished if groups as Caplin. I'm not trying to portray them as villains, come in and the rest of us still think we're in the railroad business. There's going to be attention that in the long run is going to work in favor of faculty who want to move in this particular direction. Because the very constraints that universities impose now, sometimes from tradition and sometimes from financial necessity, are going to be altering because of this disruptive impact of the technologies, I'm describing, I don't want to get into that more now, but do I want to get into that this afternoon. It deals with the next chunk and I'm sensitive of 11:00. So I'm going to do the last chunk. The last chunk isn't about technology. I've sketched the menu of technologies, I teach a full course on this in the fall at Harvard. There's many more that I could put up and talk about as transformational.

But the heart of this is the teacher. I don't build or study any technologies that work without skilled human being at the heart of them. And they work best when there's a whole communities of skilled human beings, students and teachers at the heart of them. Part of what I'm sketching is that in the national tech ed plan is called connected teaching, yes they organize the classroom, the teacher is somewhat orchestrating what's happening on the community context and the real world context using technology to do that. Whether or not it is Kansas state or Harvard that does this stuff, there are people that are working very hard to do it. And when they understand when to do it very well online, they are going to be the highway system competing with the railroads and the more we can all prepare ourselves for that and move as the technology and the finances permit us to be ready for this world, the better. Because the fact of the matter is, that the traditional institutions, including Harvard do not do a good job. They do not do a good job on this footprint. I scramble as hard as I can at Harvard to do a better job, I think when some of these technologies come to fruition and some of the institutional policies change, I'll be able to do a lot better job.

One thing that we do with these technologies that to me is a hallmark of whether we're succeeding or not. We look at the full range of students succeeding. Not just the smart students, not just the privileged students, not just the academically well‑prepared students, but everybody. Because the other side of excellence is equity, and if we build learning environments that widen the achievement gaps that we see now, we're only destabilizing society rather than improving society. So one of the things that we have done with all of the virtual environments we have built, starting with river city, we have asked teachers to predict in advance for each student in the class how motivated the student will be and how well the student will do. And typically the teachers are quite surprised by what happens, because students that they labeled as intrinsically unmotivated come alive when they are taught in these environments that speak to their learning strengths and their learning preferences and students that they think of as frankly stupid suddenly are getting Bs and As on more complex things than the conventional curriculum, because we're trying to speak to these 19 skills. Because the students trapped intelligence is being let out. And so we really do need to think about the fact that even the best conventional methods, privilege only a part of the population in some of these new technologies seem better at customizing and adopting to the needs of the full range of the position which is essential, if we're going to have a good 21st century. So what do I think is the biggest barrier? There are technical barriers, policy barriers, financial barriers, I think the biggest barriers are psychological and cultural, just like they always are, for any kinds of innovation, it is very difficult to reinvent something as fundamental as teaching. I spent all of these years as a student being taught in traditional ways, I spent all of those years as a faculty member teaching in conventional ways and now I'm having to not only learn new kinds of teaching, but I'm having to unlearn things that were previously successful, but now are inadequate.

So we know some things about professional development, whether you're talking about college faculty or daycare center providers, or pre‑college teachers. If I want to teach you about how to use a virtual world effectively, I better be doing it in a virtual world. If I'm going to teach you how to use social media, I better do it by using social media. What I've just done is to give you an hour‑plus lecture on the importance of learning by doing. What's wrong with that picture? It is what I could do in an hour. But if I do it for a semester, shame on me, because the medium is contradicting the message. So in the long run, we'll talk about this, this afternoon, if you want to talk about moves. In the long run, we have to finds ways to empower the community dimension of learning in particular, because that's the dimension that's going to get us passed some of these problems. And that's going to enable unlearning, unlearning isn't just intellectual, it is emotional and social. You look at wellness. I was once thin. Rail thin. And my eating habits didn't change, but unfortunately my body did. I had to unlearn a whole set of eating habits, you can judge the extent to which that was successful and learn a different set of eating habits and I did that through interacting with other people who had similar issues and getting emotional and social support for what I understood perfectly intellectually, that's what we're faced with days like today, we're trying to learn and unlearn together.

I want to close with having said that people are the most important thing by talking about one way in which I think people can start to be effective right now. This is a standard optical illusion. You can see an old person. You can see a young person with her face turned away. But you can't see both at the same time, because of how the brain works.

>> When I give a talk like this to big publishers, they get excited and they say, Chris, this is great, we're doing digital textbooks, we can put a virtual world, after they have done their reading, they can muck around a little bit in the virtual world. They can walk home through an augmented reality and that will help them to do the homework problems when they get home. That's the old person. That's the cake of conventional pedagogy curriculum with fairy dust sprinkled on top of it. That's not going to buy us anything frankly. But with exactly the same stuff we have now, we can try to see the young person. We don't fully understand the young person, her face is turned away, but if the cape is the active sense‑making and learning in real world settings and simulated real world settings and communities of people and the frosting is this incredible knowledge of experience and people are stuck just in time how they are learning and when it is powerful and how to use it. Then we can make that young person come alive. I hope this has been interesting to you. I hope you'll come tomorrow if you want to interact more. Thanks for much for coming today.

[Applause]

>> For those of you who want to stay for 10 minutes, I'm happy to have some dialogue now, especially if you can't come later. Or I'll just wait around up here. Thank you for coming.