

THE BROOKINGS INSTITUTION

LEVERAGING TECHNOLOGY TO RECLAIM AMERICAN EDUCATIONAL  
LEADERSHIP

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THE FUTURE OF EDUCATION TECHNOLOGY

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IMAGINING THE EDUCATIONAL ENVIRONMENT OF THE FUTURE

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THE STATE OF EDUCATIONAL RESEARCH AND DEVELOPMENT

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INCENTIVES TO INNOVATE AND ENCOURAGING EXPERIMENTATION AND TECHNOLOGY ADOPTION

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**Keynote Address:**

BOB WISE  
Former Governor (D-W.Va)  
Co-chair, Digital Learning Council

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## P R O C E E D I N G S

MR. WEST: Good morning. I'm Darrell West, vice president of Governance Studies and director of the Center for Technology Innovation here at Brookings. And I'd like to welcome you to our forum on "Leveraging Technology to Reclaim American Educational Leadership."

I think everybody recognized how important education is to personal development, social opportunity, and economic prosperity. Learning is an essential ingredient in how well people do. And I feel like, personally, I am Exhibit A in this regard because I grew up on a small dairy farm in rural Ohio, but through a great education system in the 1960s and 1970s was able to eventually end up teaching at Brown University and then coming to Brookings two years ago.

But I think many of us worry about whether today's generations of kids are going to experience the same opportunities and prosperity that others have had. We need to get more low-income use in postsecondary education and provide greater access to quality education for more Americans.

Now, there obviously are many ways to think about improving our education system, but technology innovation represents an important part of that overall puzzle. And that's what we really want to focus on today.

Technology has the potential to improve education by improving access for remote areas personalizing learning, making class times more flexible, and providing online assessment tools. Wired classrooms and instructional sets allow for education that is adaptive to student needs letting pupils learn at their own pace receiving individualized instruction and being assessed in real-time. So it represents a way to build and look at education attainment more systematically than is possible today.

To help us understand how we can leverage technology to improve

learning, we have brought together a spectacular set of speakers. Today we are going to hear from top White House and Department of Education officials about their views on education technology and education innovation. We will have a panel on improving the future education environment. We will discuss the state of education research and development, we will look at how to encourage experimentation and adoption of new approaches, and at noontime we will have a keynote address from Governor Bob Wise of West Virginia about his organization's work on digital learning.

For our first session, we are pleased to have several distinguished leaders from the White House. Phil Weiser is senior advisor for technology and innovation to the National Economic Council Director. In that position, he works on a wide range of issues related to technology and innovation. Previously, he was a professor of law at the University of Colorado.

We also will hear from Aneesh Chopra. Aneesh is the chief technology officer for the federal government. He serves as assistant to the President and associate director for technology within the Office of Science and Technology Policy, and in that position he advises the President on technology innovation and ways to encourage new approaches.

We're also pleased to welcome Roberto Rodriguez to Brookings. Roberto is special assistant to President Obama for education at the Domestic Policy Council of the White House. His task is to coordinate education policy for the administration, and previously he was chief education counsel to the late Senator Edward Kennedy for the Senate Health Education Labor and Pensions Committee.

So let's start with Phil. You advise the President on many technology issues. What should the federal government do to expand the adoption of technology in education?

MR. WEISER: Well, I'm going to start with a point that's a little bit broader that puts that question in context, if I could, which is we have seen over the last 20 or so years the information technology revolution, change in fundamental ways a series of industries operate. So if you think today about how people buy or sell stocks and how they did it 20 years ago, it has changed from people having to call up a broker and pay \$100 or so per trade to people doing it on their own with the click of a mouse, as they say, for generally \$10 a trade, right, a 10-X reduction in costs. In many cases they're getting greater quality access information, you know, at their fingertips. That's a pretty fundamental change.

Similarly, in other industries, we've seen huge ways that technology has changed consumers' behavior. Think about the development of smartphones and how people now may not say they needed or wanted alarm clocks, they've got one on their phone. They may not need a checker set because they've got one on their phone. It's created huge opportunities. In the education world, we're only beginning to glimpse some of those efforts. They've not kind of gone throughout the whole system, and that's something that, if you see that, you realize what the opportunities are.

In other industries, health care for example, also energy similar opportunities exist. And from the perspective of looking at innovation as a driver to help not only our economy but our national priorities, education stands out, and for that reason we've decided, the three of us, to get together an interagency effort to help bring the best of our thinking to ensure that our policy's effectively coordinated and framed to seize these opportunities. Because today we're glimpsing some of them, but we know we can do better. And we're very fortunate to have at the Department of Education Jim Shelton and Karen Cator and the fantastic work they're doing. You'll hear about that today.

The vision that we have in this Department of Education more generally

about improving education with every tool we have, including technology innovation, is one of this administration's top priorities. And having Roberto in the White House to help oversee and work with that is a huge asset, having a chief technology officer.

And then in my case, having someone who sees from the economic perspective why this matter is part of our overall vision to make this a signature effort of the administration, and we're going to be working on this because -- and this is worth sort of explaining a little bit -- you can lower costs and you can raise quality by using technology in ways we haven't. On range of different ones -- Darrell mentioned some -- how do we assess student learning? How do we try to make learning more personalized? How do we find ways to bring learning to people who don't have it?

So in Colorado where I'm from, Pam Shockley on the University of Colorado, Colorado Springs campus has put together a consortium of 10 institutions of higher learning in using Cisco TelePresence technology to bring education to all parts of the state where they may not have certain courses. This is something which has been talked about for a long time, but we're seeing significant progress on it.

Even in a more sort of nationwide model, a local company called StraighterLine has been able to develop \$100 a course for people who might not even be in college, but then can start taking courses and then transfer for college credit. This can make education accessible and affordable by leveraging technology. That's not the way the system was built up, and one challenge that is -- in many areas is you have a certain legacy people are used to -- change isn't easy. And one role public policy can play is to help try to create the vision and the opportunities for that sort of change.

So we're very excited about this opportunity, and thank you for joining us here today.

MR. WEST: Thank you, Phil.

Aneesh, speaking of this vision, what do you see as the biggest opportunities as well as the barriers to progress in this area?

MR. CHOPRA: Well, I focus on three, and I'll get to them momentarily. But let me just amplify Phil's comments and set the stage from a technology and innovation benchmarking perspective.

It was February of last year, Darrell; Rob Atkinson published a report at the ITIF looking at about 25 key indicators of innovation performance benchmarking 40 countries. And as most of these studies go, it rendered a judgment about whether the U.S. is number one, two, three, or four, and it ranks us six. But you could pick any study and it would say the U.S. is two or five or whatever different benchmarking studies exist to make your point.

But this particular study look at a derivative value, which is across these 25 indicators, whether you render a judgment about where we are static is one thing; but if you go back to the same set of indicators from 2000 to 2009, basically a decade, what was the rate of change? And what was the derivative value of the U.S. performance against the derivative value of the other 39 countries to be benchmarked?

And the bottom line of the Atkinson study called "The Atlantic Century" was that the United States was 40th out of 40 countries in the rate of change on key performance indicators. I bring that up as backdrop, Darrell, because just about two weeks ago Secretary Arnie Duncan -- who's a rock star, by the way and pretty huge.

MR. WEST: We thought you were the rock star.

MR. CHOPRA: Yeah, I wish. That guy's the man. Secretary Duncan, when soberly -- if that's a term -- reviewing the PISA scores, looking at performance globally, came to roughly the same conclusion. If you go back a decade on reading literature, 15-year-olds in the U.S. essentially made no progress over the decade. If you



look at math, virtually the same mediocre performance. I think in math we ranked 23rd, Jim, if I recall. And the only area we showed even slight performance improvement was in science where we went from sort of bottom of the heap, if you will, to I think 17th. So not much to particularly celebrate.

So the conclusion that Secretary Duncan drew, his words, was that a kind explanation was the lack of productivity in the educational system. And I found that framing very helpful in the technology and the innovation context, Darrell, because Profession Jorgensen had studies the overall economy since 1995 and found that two-thirds of the productivity growth was attributed to investments in IT, much in the same way Phil outlined kind of the examples, stock market and so forth.

Ergo, if productivity is at the root cause of our challenges in educational performance and in the broader context we've seen a relationship to some degree, then there may be opportunities to further understand the power of information technology, not that it's the sole, but in my voice on this three-legged stool that we're hearing, I'm particularly emphasizing those aspects, and those are three.

Number one, much of what has led to the Information Revolution has been this notion of open standards and the ability to build and scale on what works. We don't have, technologically, a standards framework that would allow us to understand how content should be distributed in the classrooms. And given the comment you made, Darrell, about personalized instruction, we really don't have a standards framework for assessments, you know. In the traditional sense -- I remember this in my state of the Commonwealth of Virginia had -- we have a statewide database like, what was your testing score, one value, the student and the teacher. That's like in a big statewide database. That's a single moment of assessment.

And as I've said on occasion, my four-year-old on her iPod touch is using

learning apps where she's making judgments literally every few seconds, and that is data, assessment data. So the notion that we're going to have a single value of assessment measured in some state database, and you've got this proliferation of tools that can allow you to assess far more rapidly, means we've got to get our arms around assessment.

By the way, on that topic, I'm pleased that under Karen's leadership and Jim's leadership at the Department of Ed, Monday will be a notice in the *Federal Register* calling for public input on standards for interoperability on issues around assessment and content. I think it's available today on the Department of Education's website and then on the *Federal Register*, that wonderfully powerful document you all love reading, on Monday.

Second, too, briefly, and then I want to have Roberto frame it, I am also a big proponent in the area of technology and innovation. If you look at productivity gains, a lot of it is on building on research and development activities. Kalil, who will speak later today, can diagnose the billion-dollar industries within IT that all have their origins in government-funded research and development. I think there's a dozen examples.

Just yesterday we were with the CEO and founder of Akemi Technologies, who I didn't know got his concepts through a DARPA grant a decade ago.

And third, and certainly not least, perhaps most importantly, we see the power of open data throughout our overall approach to productivity and innovation in the context of government more generally in the same spirit. How might we do more to leverage information to help navigate this complex field to understand what works and what doesn't?

So we can go on and on, but, Darrell, I wanted to give you those three

key policy points and then hand it off to my partner in crime, Roberto.

MR. WEST: Thank you very much. Roberto and Phil and Aneesh have teed up the importance of innovation. You coordinate education issues for the President. How can the government go about encouraging new models of learning?

MR. RODRIGUEZ: Well, I think that's actually why we're here today and why we're so excited about this forum. I think, you know, Aneesh described the moment that we have in education is sobering. The President on Monday really hit home the importance of the *Sputnik* moment for all of us in terms of American education. The OECD data and our standing on PISA, I think, really underscores the importance of doing more to really raise the quality of our education system across the board for all students in all subjects, and we really believe that harnessing technology can be a key tool and lever to do that.

We know that we are lacking behind other nations -- China, South Korea, Finland, Canada -- with respect to not only the attainment educationally of some of our students, but also with respect to some of the strategies that we need to bring to scale as a nation to really transform teaching and learning and transform our classrooms into really 21st century classrooms.

We also are framed by an important imperative that the President has shaped for us last year to again, by the end of this decade, by 2020, to lead the world with the highest proportion of college graduates. That's not just a higher education strategy, that's really an unimperative that calls for us to do better in terms of improving opportunities and outcomes for our students, really from cradle all the way through high school graduation and up through college.

So the challenges are great out there. I think we really believe, and as Phil has alluded to, education and the education sector really has tremendous potential.

If we can really harness technology, new modes of technology, and really build up the type of capacity that's needed at the school level, at the district level, at the state level to be able to implement these new technological tools to really transform learning for our students.

We also know that our students today in this generation need to be prepared with a whole new set of global skills. We need to be sure that we're preparing all of our students for college and career which means making sure they have a solid foundation in key academic subjects, but also that they have the types of skills that they need to be able to succeed in a global marketplace, that they can be strong communicators, collaborators, problem-solvers, that they can do better in terms of analyzing complex skills and really bringing the maximum to bear on that.

So, you know, I think the demand of the skills in terms of our new work force and the growing proportion of jobs that we have in today's economy really demand that we look at the education endeavor in a new light and we use technology as a key lever there.

So there are really three kind of basic -- that I'd like to outline three basic, I think, benefits to really looking at education technology to transform our education landscape. And, you know, Jim and Karen have done great work through our education technology report this year to outline these that we'll have a great discussion and detailed discussion here. But, just very briefly, I'd like to mention them.

First, really using technology to really help provide the analytics that we need to understand data better and to use data better to improve instruction and to identify what's working and what's not working and what needs greater attention in the classroom. And one of the primary modes that we can look at that, and one of the kind of key framings of that discussion, has been assessment. And Aneesh alluded to this, but

it's both looking at how we can use technology better to deliver formative assessments that provide real-time data about how students are learning about the types of additional helps and supports that they need to be able to succeed; web-based tutoring models that can really look at and study students' behavior, students' approach to problem-solving, to be able to break that down, provide a greater picture of that to teachers; also looking at what we can do in terms of harnessing technology for summative assessment.

And we've really had a great conversation about raising the rigor and relevance of our standards across the country so that they reflect college and career readiness. This is a kind of key foundation of our education approach at the White House, and we're supporting with \$350 million, our administration, the development of a next generation of assessments that are really aligned to college and career readiness that states are able to use. And we have 44 states around the country that are engaged in one of two consortia that are really developing these new assessment and looking at technology as an opportunity to really not only provide a richer measure of student learning, but also to be able to adapt that measure so that we not only can know where our students are with respect to their master of grade-level content, but we know how we can challenge our most gifted students, how we can really help our students at the bottom of the curve accelerate their learning to be able to succeed.

And finally, the importance of diagnostic assessment in what technology can do around really diagnosing learning needs early. So that's really the first piece.

The second is to look at how we can use technology to better personalize the learning environment and better respond to individual student needs. That's much more of a pedagogical exercise but one that I think is very exciting, and this is looking at how we can better engage students in learning in their classrooms, how we can use technology to really connect to students' individual interests, and really help

enrich instruction for students.

And I should say that's not just an exercise that is important within the classroom; there is the ability to personalize learning outside of the classroom, and in out-of-school learning time. And we really need to maximize every hour of a student's attention and engagement in order to really help them succeed and get the skills that they'll need to be able to succeed in college and career by the time they graduate. And that means really looking at our out-of-school environments also as important learning environments and how we can use technology there. We have some wonderful work that's going on supported by Carnegie right now looking at libraries as out-of-school learning environments and what we can do there to really engage student learning.

And then I'd say the final piece is really doing more to harness technology as a point of access for a rigorous curriculum for students, and the ability to provide and really transcend miles, to be able to deliver in remote areas and areas where we might have understaffed schools or understaffed classrooms, or we might not be able to have the type of school faculty that are able to deliver rigorous courses to be able to use technology and use digital media as an opportunity to deliver that rigorous level of instruction for students in key areas.

And Phil alluded to this. We're not only seeing this in the context of K-12 education, and obviously we're seeing a number of states -- Florida is an example -- that looks at virtual schools to be able to deliver those types of courses. We're seeing this in higher education, and our administration is deeply committed to doing more to really help in that sector as well, utilize technology as a key mode to deliver the type of courses and more enriched curriculum that students need to be able to graduate from higher education ready for a career and with the career-ready skills they need to succeed.

So thrilled to be part of this conversation, and we're really deeply

committed to moving this agenda, moving this agenda forward with all of your collaboration and help.

MR. WEST: Okay, thank you very much.

We have time for two or three questions, so we have people with microphones, so if you can raise your hand. We have a question her up front. If you could just give us your name and your organization. And we also would ask you just to keep your questions brief, too. Thanks.

MS. GETTMAN: Thank you; I'm Lucy Gettman with the National School Boards Association. I'm waving around a brochure from our technology leadership network. Public schools are absolutely interested in engaging in the transformative potential of education technology, and I'd be very interested in hearing from our panelists about ways that we can partner in this very important project.

MR. WEST: Amen.

SPEAKER: So let me start with one high-low point, and then let my colleagues join it. The challenge that happens in technology markets is you need scale, which means you have to have a basic standards, base framework so that you can have products that can scale and get disseminated. And one challenge to overcome -- I'll let my partners talk about some solutions -- is if the, you know, procurement systems or ways in which things happen are entirely diffused, that is sort of a considerable barrier to get over. So in terms of possible ways to do that, I would say a couple of things:

One, please help us distinguish nouns from verbs. What I mean by that is --

SPEAKER: He's an English professor.

SPEAKER: Yes. When I served at the state level, one of the pleasures that I had was to visit schools in every corner of the Commonwealth. And, inevitably,

because I was the secretary of technology, the school board, or the host of my visit, wanted to show me the nouns: Look at all the hardware and the software and the electronic blah, blah, blah, and isn't this amazing? And I would pretend to smile. Inside I was ripped apart because I was focused much more on the verb, to what end? What purpose are we pursuing the acquisition of these tools? And you could help a great deal myth-busting by less -- man, I had school boards telling me our capital plan is going to put millions into X, Y, and Z, name-your-vendor-blah. And I was just heartbroken because they didn't articulate any particular problem they were solving with the introduction of these high-cost --

And then what was really depressing is I saw most of that happening in parts of the country that really didn't have resources for much of anything. I'm a frugal engineering guy: design constraints, low-cost, build and innovate around those constraints against a verb. If my problem is getting the underperforming students up to a certain level, how we pursue, so that's goal one.

Goal two, once we articulate the verbs, you can form a coalition of the willing to encourage entrepreneurial thinking to find new approaches to address the verbs, because if it is just the narrow sliver of vendors that live only in the education technology world kind of continue to incrementally improve their wonderful products, we're not going to get to where we want to be. What we need is a platform for new thinking, breakthrough ideas, new entrepreneurial activities that could enter the market because you've given them a much clearer picture of what you want.

So if we shift to verbs and form a coalition of the willing -- I'm just on the fly here riffing for you as a school board leader -- I am confident you can be a catalyst for break-through ideas entering the market far more than, you know, frankly, federal policy in this issue, organizing at the grass-roots level community by community coalition of the



willing, we're with you. We want to be there to help.

SPEAKER: You know, Lucy, we've had this frontier that I think in approaching technology in education we've really -- the entire conversation has been around connectivity and has been around some of that Aneesh is alluding to of putting a computer in a classroom. And we all, all of us that have visited, done classroom visits, have seen these computers sitting in a corner not being utilized by teachers in their lesson plans or an instruction. That's not to speak ill of teachers. It is to say that we need a different conversation about what technology looks like with respect to addressing student learning needs and how teachers and how principals and other school leaders can really use technology in new and innovative ways.

And that's precisely what we embark to try to engage in here is to try to do more to demonstrate how technology can be used to improve instruction. And with educators, and you know this, you don't -- they don't -- the ah-ha moment is not until they're actually in another classroom seeing something used. And until you break down the barriers -- and a lot of those are perceptual barriers of, you know, that's not for me, I can't use that. I have -- you know, I'm supposed to be on page 24 on day 5 of my pacing guide.

Until we kind of break through that and say, okay, this is how you can actually use and embed technology as a key tool to deliver core content, that's really what we're after. And I think we're just -- there's a whole host of ideas out there that we can mine and really bring to scale. But unless there are really almost a potential of those ideas is owned by folks in schools, we're not going to get there.

MR. WEST: Thank you. And this morning we will pursue many of those ideas.

We're out of time on this session, but I want to thank Phil, Aneesh, and

Roberto for sharing their views with us. Thank you very much. (Applause)

SPEAKER: Go, Jim, go. Go, Jim, go.

MR. WEST: That's a pretty good introduction right there.

For our next session, I'm pleased to welcome Jim Shelton to Brookings.

Jim is the assistant deputy secretary for innovation and improvement in the U.S. Department of Education. In that position, he works on teacher quality, school choice, and learning technology programs. Previously, he served as a program director for the Education Division of the Bill and Melinda Gates Foundation. And, as you heard earlier, Jim along with Karen Cator, who we'll be hearing from later, put together this amazing report on education technology and personalized learning.

So please join me in welcoming Jim Shelton to Brookings. (Applause)

MR. SHELTON: Good morning.

SPEAKER: Good morning.

MR. SHELTON: Yeah, I'm in education. I say "good morning," you say "good morning," back. Good morning.

GROUP: Good morning.

MR. SHELTON: Good deal. So, first, Darrell, thank you very much for hosting this here. I couldn't be more honored to be here with you, and I couldn't thank you more for actually bringing attention to this important issue. Of course, then, you did what you probably should never do to another one of your guests, which is ask me if I was nervous before I came up here, which, you know, I was trying not to be. And then I was reminded that my boss is a rock star, and then I'm coming on after the U2 of federal policy. And then I recognized also that I'm being followed by, you will see, folks that are masters of communication and rocket scientists, in some cases literally.

But all of that didn't make me as nervous as the fact that last night I was

going over my remarks that I've been working on for a couple of weeks, and I had -- for those of you who don't know, I'm a recovering management consultant -- and I had an experience that I used to have when I was a consultant, which is what I call the *Jurassic Park* moment.

Many of you may have seen this movie where, in fact, there is a world's best hunter, who is on this island with the folks, and there's all -- it's fraught with danger. And at some point he has to protect everyone from these velociraptor dinosaurs. And he goes out into the jungle because he knows that there's just one out there. And just as he is about to take him out, he realized the other one is about to eat him.

I used to do my consulting work in telecommunications, in the airline industry, primarily. So there were times when you would be working as a -- when you work for a top firm, you have the opportunity to work for companies that are at the top of the food chain. And so you work on opportunities and how you describe the opportunities for them. And you're working them for months, and then sometimes what happens is that at the very end you go, oh, crap, I wasn't looking this way.

That's what happened to me last night. And let me tell you why. See, the basic story line that all of you who are here know is this: The situation? We are underperforming on education. The complication? We have to hurry up and make a change. The resolution? Technology can help us do that. Great. Here's the challenge: In the amount of time that we actually think that we have, we don't. Let me tell you why, and I will apologize for being your "downer" for the morning in advance.

You see, the reality is that we have pursued education and education technology in much the way that Aneesh described, from position of a market leader that is dominant where, in fact, we believe that we can maintain our dominant position by investing in our core systems.

Terry Moe, who will be up here later on to talk about the impact of that on other industries and sectors, and we'll see actually the implications of how that plays out here.

We have heard our President say that the countries that actually out-educate us today will out-compete us tomorrow, and that is still fundamentally true. The correlations between education and prosperity at both the micro individual level and at the macro national level still hold. But the reality is also that while we are standing still, not only are other countries passing us by but they are increasingly improving on the trajectory at which they are making improvement.

Let me say that again. Not only are other countries passing us by, they are getting better and better at figuring out how to increase the pace at which they improve.

McKenzie & Company just recently released a report called *How The World's Most Improved School Systems Keep Getting Better*. For those of you who haven't seen it, it's an interesting taxonomy. They have now broken it down between systems that are poor and how they move to fair, from fair to good, from good to great, from great to excellent. And what it shows is that there are systems around the world that have made dramatic progress, not incremental progress, dramatic progress in as little as six years moving from one category to the next.

The thing that is important about that is that this is one of the first times that we have seen management science applied to the context of educational performance improvement. And once you start to have that kind of understanding of the products and processes involved in making that kind of progress, then you can actually apply technology to them to improve the pace at which you actually make improvement. You can involve, you can enervate at an accelerated rate. So now that some of these

things are starting to be demystified, we will see an increasing gap, not only for ourselves within our country but between us and the rest of the world.

Think about the U.S. when it came to cellular telephony. We led in the innovation and the opportunity. But because we had an investment in the infrastructure of our core landline system, and other countries started off without that infrastructure, they leapfrogged us in the use of those technologies. Other countries today find themselves in that unique position. They see the same correlation between prosperity that we do -- education and prosperity that we do, and yet they can't train the teachers or build the schools fast enough. Therefore, they are going to find other ways to get there from here. It's just that simple. And, believe me, they are turning to technology. Because of the fundamentals of the technology world, they are going allow this transformation are the same everywhere.

Think about it. In a few years ubiquitous broadband, ever cheaper devices, mobile devices any time anywhere, plough computing meaning I don't have to have all that capability even in my device. I can deliver the power of the most powerful computers from anywhere to anywhere, and big data, meaning now I have the ability to take all of that instrumentation that we have out there, to gather all the data about what's actually happening in human interaction and mine it. If I have a great hypothesis about what's happening, even better, but now we can actually crunch enough data when we don't have a hypothesis to understand the patterns.

That infrastructure creates an entirely different infrastructure for learning and learning technology. It bodes the opportunity for people to make rapid progress in understanding what works, what doesn't, and in what context in ways that has never happened before. And it means that, in fact, people who have to make rapid change, people who have large populations that have been excluded from their educational

systems, say, China, will start to figure out how they actually create this infrastructure to make much more rapid progress.

If that wasn't enough that the imperative of the nation's educational system wasn't enough, the reality is that education is more than a \$2 trillion industry worldwide. It means there is a tremendous opportunity for the reallocation of public resources and for opportunities on the private sector side. And regardless of how we feel about that here in the United States, there are people and entrepreneurs around the world who see that opportunity and who are going to pursue it. There are nations who actually understand it and are going to pursue it.

Think about the aerospace industry which is only \$1.3 trillion, but most countries see it as a strategic industry. We have watched the motivations and the machinations of nations around the aerospace industry for years worrying about how they subsidize their state-run airlines and how they position themselves on competition of airlines. What do you think is going to happen when they pivot towards learning and education as a strategic industry for their countries?

And then, finally, the half-life of skills and industries, as many of you may have read in John Seely's most recent book, that half-life of those skills and industries is getting shorter and shorter. We're seeing whole sectors disappear in less than a decade. Think about Blockbuster meeting Netflix, Netflix's version 1.0 with the mail meeting Netflix's version 2.0 with delivery to your home. Whole segments of industries, whole organizations, whole companies come and gone in less than two decades.

New skills acquired, new opportunities created. How do you move quickly to reposition your entire labor force, your adults and your young people, when industries and skills and knowledge move that quickly? That is the challenge facing the nations of the world, and it is one that you will only be able to actually address with

technologies that allow you to move that fluently and to evolve that quickly.

The second thing -- I've mentioned this earlier -- the science of teaching and learning is not at a point of inflection. What we now understand about neuroscience, cognitive science, behavioral science, motivational theory, and, as I said, management science, we now have a deeper understanding on how those things impact learning than we've ever had before, and that's without trying. This country invests .1 percent of the industry in R&D for education.

Most mature industries spend between 3 and 5 percent on R&D. Most industries that are innovative spend up to 20 and in some cases 25 percent on R&D. What we know is that technology enhances our ability to take advantage of the new insight in all these different areas. It accelerates not only the pace at which we can improve learning outcomes but the pace at which we can learn about these learning outcomes. You know, that's something that both Tom and Bror will talk about later.

The other thing that makes this important is that once you actually understand and build this infrastructure, you can build this in advantage and exploit that advantage that's sustained over time. So in other words, the countries that invest first in the infrastructures that support advanced work in learning technology and the understanding of how learning happens over time, will be able to build exponentially over time on that infrastructure because their pace of learning about learning will keep growing at the same time. And, as I said earlier, other nations are willing to invest.

So I laid out two fundamental reasons why we have to get moving and rather quickly. The good news for us is that this is when we are at our best as a country. We can talk about *Sputnik*, we can talk about the Internet, we can talk about the human genome. In each of those cases, we as a country have actually traded the opportunity to build new sectors and new industries to address the problems facing our countries and to

propel ourselves back into a position of American leadership. We have to seize that opportunity now as a nation around learning technology, and the opportunity is significant because what we know is that the what is powerful.

People are very kind to say Jim and Karen did a great job creating national education technology plan. Jim is verbally challenged. Karen did a great job putting together a national education technology plan. And the most important thing about it is that it says learning powered by technology. When Karen talks, I'm sure she will talk about the need to create a learning nation and the ways that technology can actually help us to do that.

So let's talk about, then, what is it, specifically, that we need to do to reach this new world, because we're going to talk about the what, but the how is very, very important. What we know is that we have to invest in accelerating the development of breakthrough technologies. We know the importance of DARPA on the defense side and the aerospace side. We know the importance of NIH on the health side. We don't have the equivalent in education, and we know that we need that kind of investment from government to stimulate the investment that we need from the private sector.

The second, this new R&D infrastructure we know is going to be critically important to making the kind of leap forward that we can. It's something that the colleges and universities as well as our government agencies need to take seriously and need to find out how we leverage the resources in the work that we're doing so that we get much more leverage out of the minimal resources that we're putting into R&D today.

And the third is, as you heard said, is that we have to create as much different ecosystem and environment that's actually much more attractive to entrepreneurs, both social and otherwise so that you get more philanthropic bang for your philanthropic and traditional capital market buck.



I was so glad when the woman from the NSBA asked the question about what needs to happen. People say why doesn't innovation happen in education? The market is the toughest market, I think, in the world. It's highly fragmented. And, most importantly, performance does not dictate outcome, opportunity, or scale. You can be the best and not be able to penetrate a district or school even for years.

We can do things to change on all of those fronts, and if we do, the opportunity is tremendous. Before us we have the opportunity to close the gaps that don't make sense. We know that there's a 4- to 5,000-word gap between the students who start school well, well prepared and the students who don't. Why don't these learning apps close that gap for us? Any parent or grandparent in the room who has a child under the age of 3 knows that you can buy 15 minutes with a mobile phone at any point.

Someone who knew the truth.

Why aren't those things filled with rich content that actually drive to outcomes, and every time a child interacts with it, why isn't it actually collecting that data to help us understand what the profile is of that student and what they need to do to actually get ready for school? How close are they, and what actually should they access next? How do we use technology to help teachers with the challenges that they face every single day?

Think about it. We ask a teacher to walk into a room with 20, 30, even some cases now 35 to 40 students and know exactly what each student needs, know exactly what they're interested in so they can be motivated, and then connected to the tool and resources that are going to be most useful to them at that particular moment in time, to group the students accordingly, et cetera, et cetera, and what do we give them to do that? A whiteboard or, at best, a digital board that doesn't have any intelligence in it

other than what it allows you to project on it.

Why does a common retail site have more insight into what you want next than a teacher in front of the classroom has about their students? And we're doing all this in the face of a challenge that we know is the most important one we're going to face for a long time, an economic environment that demands that we figure out how we do all of this with less than we've ever had before.

Our aspirations are going up, our resources are going down, there is no other time more pressing for innovation than this particular moment in time, and we have the knowledge and the know-how. The question is do we have the will? Anyone who has used technology in their own lives and then walks around our schools and sees our students tuned out in a way that you know that you've seen them tune -- exactly the opposite way that you've seen them tuned in when they're using technology outside of school in every other environment knows that there's something wrong with this picture.

So from the individual moral perspective, from the national security perspective, from the economic perspective, and from the commonsense perspective we have the opportunity, and we need to seize it. The question is, will we? Thank you.

(Applause)

MR. WEST: Jim, thank you very much for that strong wake-up call. It's very sobering to see other places spending up to 25 percent on research and development, especially given the links that you laid out between infrastructure and some of the education and economic benefits.

Our next panel is going to be moderated by Russ Whitehurst. Russ is the director of the Brown Center for Education at Brookings and the holder of the Herman and George R. Brown chair. He and his speakers -- I'd like to welcome them up here -- will be discussing the topic of imagining the education environment of the future. So if

Stacey, Karen, Terry, and Tom can come up?

MR. WHITEHURST: Good morning. I had prepared remarks, but the White House took them all and said all of the important things.

So, I'll reframe my introduction by offering to you the premise that education, at some point in the future in the U.S. -- maybe it will be 10 years, maybe it will be 20 years, maybe it will be 30 years -- will look dramatically different than it does now. And that dramatic transformation is going to be driven by technology.

We've heard Jim and others allude to the urgency of pushing that transformation as quickly as possible. It's a national imperative. This panel is about imagining the future, and we're going to frame it in terms of what's the fuel that will move that transformation forward? And what are the barriers to doing so?

The speakers' bios are in your folders, so I will not spend time on that. We'll just move to the questions, the answers, and the issues.

So I'll turn first to Karen Cator. Karen is in the Department of Education. She heads the technology program there. You've heard that the Department has recently issued a technology plan for the future. So, Karen, my question is, how is your plan going to generate a rapid transformation to new ways of teaching and new ways of learning?

MS. CATOR: Thank you. And that's for all of the opening comments. Really did frame this unbelievably well.

So, what the National Education Technology plan does -- and this is also available digitally, of course -- the -- and hopefully what you can see is, it's about learning.

So really what this does is, as suggested, provides the verbs. It talks very little, if any, about the nouns, and talks about the verbs. What do we need to have

happen?

So it really does kind of five things. First of all, it articulates that high-level vision of what it looks like to have a powered-up learning environment. And it goes from early learning all the way through career, really thinking about how people learn today. What is the opportunity for learning? So, articulating the high-level vision is a first thing.

The second is that it's tied to the ground with research, with practice, with -- it's chock full of sidebars of examples. So this is really important because this is one of the ways that we will, I think, make progress is by looking at kind of what's happening out there.

The National Education Technology Plan was actually created with a technical working group from colleges and universities, practitioners, policymakers, people who really made sure that it was tied to the ground with the strongest research and practice and evidence that we could find.

There are five sections of the plan. And then a very important section called Getting Started Now. We published this draft online last spring, and got lots of public comment and talked about it widely. And one of the things that people asked, just like people are asking today; okay, what do we do first? How do we get started? What do we need to do? So there's actually a section in here called Getting Started Now and it's like, this is actually what we will do in the next five years from the Department of Education standpoint.

So, let me talk really quickly about the five sections. The five sections first starts with learning. The biggest, baddest, broadest section of the plan and it lays out all of the verbs associated with personalized, engaged, interesting learning environments that are powered up with technology. The opportunity to provide students

what they need to be doing every single day so what they're doing is as productive as possible.

Second chapter is about assessment. And people have been talking about assessment all day today. The Holy Grail being that assessments are embedded throughout the day, throughout the year, throughout everything that students are doing so we get smarter and smarter, better and better at providing them the interventions, the resources, the interesting experiences that will move them along their personal trajectory.

The next section is about teaching. Interestingly, the most difficult section. We wanted to make sure that nobody got to the end of the teaching chapter and said something like, oh, I get it. Technology will replace teachers. On the contrary, it absolutely will power up the teaching profession. We focused on how people can move themselves as professional educators, how they can be highly connected to the data, to the tools, the content, the resources, the experts, and whatever else they need to be as highly effective as possible. So, the teaching section was about the highly connected educator.

The next section was infrastructure. It kind of said, okay, if we buy the teaching, learning, and assessment vision, then what do we need to put this in place? Broadband everywhere, devices in the hands of students and teachers, all the time. And we need, obviously, everything else that goes along with it. That was the only part that got anywhere close to sort of, how do we do this.

The -- and then productivity was the final chapter. And Jim talked a lot about productivity. We need to make sure that our systems are as productive as possible so every single student is making progress every single day. And I'll say one last thing, the whole vision is really associated with making sure that learning is not "individualized" as in everybody's just headphones on, doing what they do. But this vision of learning is

incredibly social and participatory, as we know the learning experience should be.

Thank you.

MR. WHITEHURST: Thanks. Tom Kalil is in the Office of Science and Technology Policy, where he's the deputy director for policy. Tom and I have had some conversations about this, and most of the planning and rhetoric around transformational educational technology focuses on the supply side. So, we'll invest more in R&D, for example, so we have better products.

Tom has been thinking about the demand side of this equation, which was alluded to in earlier comments. And so I wonder if you could talk to us about that, Tom.

MR. KALIL: Sure. Well, as Jim noted, we invest .1 percent of K through 12 expenditures in research and development. So that gives us some sense for why technology has not had the same impact in education as it has in other sectors.

And I believe that it is imperative that we increase research and development in a series of fascinating ideas about how technology might improve learning outcomes, whether that's developing digital tutors; or taking advantage of advances in educational data mining and learning analytics; or developing high-quality interactive simulations that allow us to understand concepts involving time and motion in a much more intuitive way; or developing games that are as compelling as *Halo 3* or *World of Warcraft*, but teach us something more than how to kill monsters and take their treasure; or with the advance in technologies like personal fabrication, the emergence of the \$1,000 3-D printer, create an environment in which a kid can design, fabricate, test, and sell just about anything in the same way that we saw with the *Star Trek* replicator.

But I think an issue that we don't talk enough about is the demand side. And clearly, as Jim noted, for the entrepreneur the education sector is a challenging one.

You have 15,000 different school districts, you have lengthy adoption cycles, you have low per-pupil expenditures on software. You don't have a lot of independent, rigorous evaluation that would pass the Russ Whitehurst test of being high-quality educational research.

So, it's no wonder that, you know, venture capitalists are not lined up around the block to invest in this sector. Or, why it's possible for a company that is developing yet another first-person shooter game is going to have a higher development budget than software for middle school math and science.

Well, it turns out that the global health community faced this same problem, which is that if you're a pharmaceutical company, left to your own devices you will invest more in male pattern baldness or another Viagra drug than you will in vaccines for diseases of the poor. And some economists came up with a very clever notion called an advanced market commitment. An advanced market commitment is a purchase order for a product which does not exist yet. So, five countries plus the Gates Foundation -- almost at the level of its own sovereign country -- said to the pharmaceutical industry, if you develop a vaccine which is safe and effective, we commit that we will purchase a certain number of doses at a certain price per dose. And that has motivated for-profit pharmaceutical companies to accelerate the development of vaccine that is going to save the lives of millions of children from pneumonia and meningitis.

Well, the question is, if we can do that in global health, why can't we do that in education? So, what would be required?

The first thing that we'd have to do is to identify some learning outcomes where everyone agrees, A, it's important; and, B, we have some idea of how we would recognize when a next generation learning environment would be able to deliver that outcome. So we'd have to have consensus on both the ends and the means.

So, I'm not an education expert, so I hope that you treat this as a provocation and have people who actually know about education to do a better job of defining some potential learning outcomes. But let me just give you some examples.

What if we could make every C student in Algebra -- or middle school math and science, more broadly -- an A student? What if we could have a dramatic improvement in learning outcomes?

What if we could greatly reduce the gap in vocabulary size between rich and poor kids? In Beverly Hills, there are 198 age-appropriate books per household. There are .02 in Watts. Can we do better than that with mobile devices, cloud computing, speech recognition, text to speech, game design, that type of thing?

Could we allow adult learners who are struggling to balance competing demands of work and family and gain new skills to do so in a third to a half of the time? There's some research from Carnegie Mellon University that suggests that's possible.

Could we enable an English language learner that is reading two grade levels below grade level to catch up over the course of a year in interacting in an external generation learning environment?

So, one potential scenario would be that the education community could, A, define some of these learning outcomes; and then B, how to create a large enough carrot either in the form of an advanced market commitment or some other procurement such that the entrepreneur would have a reasonably high level of confidence that if they delivered a product that met that learning outcome using a predetermined assessment instrument, that there would be a market?

So, I firmly believe that all of the technological innovation that we're talking about is also going to require institutional innovation. So, we have to look at new policy instruments like advanced market commitments. We have to look at new, you



know, learning policies like moving towards competency-based assessment as opposed to student credit hours.

So, I hope that we can be focused not only on these incredible opportunities in technological innovation, like digital tutors and educational data mining and learning analytics and serious games, and all these other things, but that we could also be focused on institutional and policy innovation as well, so that we could actually achieve the ambitious goals that Jim talked about earlier this morning.

MR. WHITEHURST: Thanks, Tom. That's almost a Brookings-like policy proposal. I really, really like it. So if things don't work out for you at the White House, you know where to find me. (Laughter)

Our next speaker, Terry Moe, is a friend and colleague and published a book in 2009 that, I think, is a fresh and important examination of the politics of technology change. There's a sense out there among many of us that if you build it, they will use it. And I think Terry has perhaps a jaundiced view about the speed with which that will happen.

So, Terry.

MR. MOE: All right. You know, Jim Shelton said that he was going to be

--

SPEAKER: Microphone.

MR. MOE: -- the downer at the conference, but he's not. I am.

So, look, I think that long-term -- and I mean long-term, right? I don't know how long this is going to take. It could take 10 years; it could take 50 years, no kidding. Technology is going to completely transform American education. It's going to revolutionize the way students learn, the way schools are organized, the way teachers teach, everything.

And right now, it's early. This is just beginning to get going. And I think most policy makers and most educators; it's just not on their radar screens. It's like for them, I think it's like computers in the classroom are something. That's not what this is.

This is a true revolution in the way education is carried out, and I think it promises enormous benefits for students, and for the nation.

All right. So the question is how are we going to get there? That's the depressing part, right? So I think that when most proponents think about this, the way they think about it is that it's going to be driven by the benefits of technology, you know, which in large measure it is. Right? It has so much to offer. And the idea is that if you can provide it, if you've got the ideas, they will embrace it. Right?

Well, you know, that's not entirely true. Everybody knows that, you know, educators and policy makers are sort of wedded to, you know, traditional schooling. And they think that that's the normal way to educate kids. Of course, it is. And that this newfangled stuff -- kids working on computers -- it creates all kinds of problems and, you know, how are the kids ever going to get socialized, and computers can't teach as well as teachers can, and they need, you know, one-on-one help from a teacher, and so on. And then there are all these issues about how are we going to hold these new kinds of schools accountable? How are we going to fund them? What are we going to do about regulating these schools, because the regulations have to be completely different because they're not anything like regular schools, right? So there are all these problems.

And as a result, people are just sort of resistant to it. It's a normal resistance that you would find with any kind of innovation, right? And I think all these things are legitimate. I mean, there are good reasons why people would be skeptical and why they would worry about how we're going to regulate these new things, and so on.

But there's another kind of resistance out there. This is the depressing part, right? The other kind of resistance has nothing to do with whether technology is beneficial for kids. What happens is that technological innovation is threatening. It is threatening to jobs and to the existing distribution of money. And there are powerful interests that care about jobs and money. Right?

And I sort of -- I think most conferences like this just talk about the technology side and they would really rather not talk about the political side. And, you know, I don't want to make anybody uncomfortable, right, but the fact of the matter is that schools are government agencies that are run by the government. And if these innovations are going to be adopted, they're going to be adopted through the policy process. Okay, that's a political process. And that is shaped by power and by interests.

So, big picture? What is the advance of technology? It is the substitution of technology for labor. That's what this is. And historically, that has been the key to progress and productivity across all industries through time. It's the key to increasing productivity, efficiency, standards of living, everything. And education has been immune to this, you know, forever. It's been a teacher and 30 students and, right? This is this basic way of carrying out education. Now, that's no longer true. Now we can substitute technology for labor and there can be enormous gains because of it.

But what that means is, we're not going to need as many teachers per student in the future. That's a very good thing. Technology is cheap, labor is really expensive. This is great for society, it's great for kids, just not good for, you know, the existing pool of teachers and it's not good for the unions, right?

So, the fact of the matter is they're very powerful and they are -- they don't like this. They are threatened by the substitution of technology for labor, right? And so they are resisting this and using their power to keep it at bay, to limit its expansion.

Also, there are other dimensions to it. One is that online learning, virtual learning basically breaks the constraints of geography. You don't have to have schools in districts with teachers and kids all concentrated in the same place. They can be anywhere. The schools can be anywhere, the teachers can be anywhere. This is bad, right? From the union's standpoint it's very difficult to organize teachers who are all over the place. It's bad from the district standpoint because they can't control the teachers who are out there, and the money, and so on. This is not a good thing from their standpoint.

Also, technology just proliferates choices. This is a really exciting thing. This is going to be the biggest boost to school choice that's ever happened. Well, what that means is that when parents and kids and families have new alternatives they can leave the regular public schools. This is not good if you run the regular public schools.

Okay. So, there is now political opposition to this that has nothing to do with its benefits. And in the future, this will just continue, all right?

There are reasons why. You know, say in Oregon. You know, if you're a virtual school you have to organize or enroll half the kids from your district. Well, you know, from a technological standpoint, that's stupid, right? Because you can enroll kids from everywhere, right? There's no constraint -- well, they want it to be constrained. In California, a virtual school can only organize kids, enroll kids, from contiguous counties. Why do you suppose that is? In Wisconsin, there's a 5,000 student limit statewide on the number of kids that virtual schools can enroll. Why is that? They're just keeping a lid on it.

So the potential is just tremendous, right? There's this dynamic market ready to go but there are forces at work in the political process that are trying to bottle it up because it's threatening. So, I think it's important -- you know, maybe people don't

want to talk about this, I assume they don't. But it is a reality. It limits the progress that we can make, and I think the fact of the matter is that it is going to make progress slow and difficult. And it's very important for proponents to know what they're up against and to push it. Because this is not going to happen unless it does get pushed and it's not going to happen in our lifetimes if it doesn't get pushed. But when it does happen, I think the benefits are going to be extraordinary.

Thank you.

MR. WHITEHURST: Thank you, Terry. And I'll leave it to the audience to question you. (Laughter)

Stacey Childress is one of the chieftains of this independent nation called the Gates Foundation that was alluded to previously. They're actually, in some areas of education R&D, investing more than the federal government. And they plan. And those are two very powerful levers for change. They do have a new technology plan, and I'd like Stacey to talk to us about it, and, again, address the question of how it moves us from here to a dramatically different future.

MS. CHILDRESS: Great. Thank you, Russ.

I would like to try to pull together a number of things that have been kind of in the ether this morning, both from the first panel and Jim's remarks and my colleagues here, and put it in the context of what this might look like for a student if we had all of these terrific innovations and this infrastructure and the policy context.

And so just a thin slice of that. What if instead of thinking about schools and classrooms and -- we imagined students as each having their own learning map, a personalized trek to success, and started from that premise.

Every student in America had one of these maps. And they had a data-enabled GPS system embedded in that map that could help them traverse their learning

journey with the tools they needed to be successful. With the kinds of innovations we've been talking about this morning, that's possible, imminently possible. And almost every technological building block to at least get that started is available. And as some have pointed out this morning, in use in other sectors to great effect.

So the challenge is how do we begin to move those technological tools, know-how, advances, brains into the hands of students and teachers at the learning moment? So that that kind of vision for how students could navigate over time becomes a reality rather than having to wait 50 years, perhaps in 5 or 10 years. So I think that's a big question for all of us.

And one good question is, why now? And Terry was raising some of this. The claim that technology would -- is going to transform education is not new. I mean, we've been hearing this for decades and it simply hasn't happened. And I think a number of folks this morning have identified some of the trends and the coming together of forces that make it more likely now than before. But one thing we haven't talked specifically about that I want to double-click on just a little bit. We talked about open data standards and standards for content and those kinds of things, and we absolutely have to have a standards infrastructure to make innovation pay off at the value added point of teaching and learning. The other kinds of standards we need for that are academic standards.

And one thing that we have today that we didn't have a year ago today is that 44 states and the District of Columbia have voluntarily signed onto a common set of academic standards. Which means for the first time we have a roadmap to success that goes coast to coast. Now as a platform for innovation, for entrepreneurs and technology providers, and for the demand side that is a very powerful dynamic that we didn't have just a year ago.

One of the dynamics that that set of standards creates -- and we're starting to hear this in our work in schools and districts. The train is coming. Adoption of the standards happened in boardrooms. Only 44 boardrooms. Implementation of the standards is going to happen in hundreds of thousands of classrooms, and there is a time limit attached to those. They must be implemented over the next couple of years. And so we're actually hearing from teachers and from school leaders that they need tools now, content now, that helps them move their students from not great performance on the current mediocre standards regime under which they're operating in their state to fantastic performance against a much more demanding set of standards. And that's a huge innovation challenge, but it does create more momentum, more pressure to find ways to help students to meet those.

And we've known for years -- and kind of traditional teaching and learning community has acknowledged for years -- that differentiated instruction, you know, personalized learning, you know, Bloom's finding on the 2 sigma effect of one-to-one tutoring can help move students in dramatic ways. And technology can actually make that possible at scale in classrooms.

So the coming together of all of these forces at once out in the ecosystem really does make now different from a year ago or five years ago. It doesn't make it inevitable, but it does make it different.

So, some of you know I was on the faculty of Harvard Business School for a number of years before joining the Gates Foundation last summer. And one thing that we do is case studies. Cases and cases and cases. And so I'm still kind of wired that way. So I wanted to give you three just mini-examples of things that are already going on that just give a hint of what the promise could look like if we imagined students having learning maps that were data-enabled and allowed them to move toward mastery.

Reasoning Mind is an organization based in Houston that some of you might know. They have an online mathematics set of courses. Starts in third grade, currently goes to seventh grade and they're building up. It's a complete learning environment for students -- virtual learning environment, but it exists inside classrooms. And they're getting some pretty remarkable results. And the key is that the program adjusts moment by moment as students move through the content.

Now, the student thinks they're just moving through this fun, engaging way of doing math. And it turns out all along the way they're receiving progress checks. And the next activity they do every time takes into account everything they've done before, including that very last thing they did to assign the next set of exercises, tasks, problem sets. That's happening now in classrooms all over the country, touching about 20,000 students. And teachers have a dashboard where they can punch in at any time and see where every kid in their classroom or sets of classrooms are, and their learning trajectory. And then spend their value added time with students one-on-one or in small groups going deeper only on the things that those students really need deeper help on, and letting the technology take care of the normal path to mastery.

Wireless Generation, a company that many of you know, has an early grade literacy program product called Bursts. And Bursts lets teachers have on their smartphone or PDA a program that allows them to continuously just put very low-intensity data in about how students are doing on reading aloud in the classroom. They upload that into an intelligent engine, they get back on their smartphone, some suggestions about what to do next for every kid in the class, and some suggestions for grouping for one-on-one or small group instruction. That's already in use.

Many of you know School of One. School of One in New York takes content from various suppliers, maps that against a learning progression for every



student, and every day students have a personalized playlist much like you can do with your iPod that is specifically designed for that student that day, depending on what they most need next based on what they did yesterday and the day before, and the day before.

All of these are still relatively early stage and have a long way to go, but all of them are in use in districts, in classrooms now. And so the challenge is how do we really blow that out.

So we think, in our team at the Gates Foundation, which is the Next Generation model's team, that we need at least three things. And these are big categories. One, we need more of these building blocks, right? More of the content, more of the tools, more of the algorithms that use data just, you know, ubiquitously to help students move along. We've got some, but we need many more of those. The more of those building blocks we have, the more kinds of learning models -- not just the Schools of One, not just Rocket Ship -- we've got, you know, the same five guys are showing up at all of the conferences like this to talk about their terrific -- it feels like a movement. Yeah, there are five. And it's always the same -- I love them, and we're supporting many of them. But, you know, we need 50 or 500 that are really trying not just to deliver online learning, which is important, but to figure out how do you really use technology at the teaching and learning moment to dramatically unbundled and personalize learning experiences for students.

So we need many more of those learning models, and more building blocks will help us get more of those learning models, and vice versa because of the supply demand.

And then as Terry was talking about, we need an enabling environment that allows these kinds of things to really get created and then proliferate rapidly, and at

scale. It includes policies, it includes the political context, and it also includes the market conditions that make it attractive for entrepreneurs to do this. And so these advanced market commitments and demand aggregation activities are incredibly important at the same time we're investing on the supply side along with private capital. We think all of those things have to do it.

So, let's just as I wrap up, go back to that map analogy for a second. And one way to think about it is maybe not a killer app for education, but it certainly is an application that could catalyze a lot of innovation. So if you had these data-enabled maps that sat on an intelligent engine and every kid in America could have one, think about the incentives for entrepreneurs to find ways to plug tools and content and micro-assessments into the nodes on that map to help students have lots of options about how to move through. Really could accelerate an ecosystem of development on tools and content that students and their teachers and parents need to help them move.

Another exciting thing about this -- and I'll wrap up with this -- imagine the power those sorts of maps could have in putting students -- more of students' learning in their own hands. And so when students are younger and earlier in their learning trajectory, maybe a digital backpack that has kind of a set of tools that are pre-selected with lots of expertise, and they have exactly what they need to traverse their maps. But as students moved on to more complex learning tasks you can imagine them earning, at some point, a digital driver's license, or a learning passport that allowed them many more options, many more ways to explore and experiment with their own learning. But all against a very high bar on what the learning destination is supposed to look like.

So, lots of movement and different paths and different trajectories, but heading in the same place, which is the high-quality learning outcomes that we all agree have to be in place to solve some of these competitive issues that folks were talking

about earlier.

I'll stop there.

MR. WHITEHURST: Thank you. We're going to take a couple of questions from the audience. There's an older piece of technology that has an imperative from me, and that's the clock. I have an obligation to be somewhere else. So, I'm going to ask my colleague Darrell West to moderate the question period. Thanks.

MR. WEST: Question right there?

So if you can give us your name and your organization.

MR. McTIGHE: Sure. Joe McTighe from CAPE, the Council for American Private Education.

I think more than any other education reform, technology lends itself most readily to universal application, whether it is the level of schooling -- pre-K through higher education; or the location of schooling -- classroom, non-classroom; or the sponsorship of schooling -- public, private, home.

The Bob Wise-Jeb Bush manifesto called for universal access to publicly-funded digital learning, regardless of the type of school the child attends. Is that part of the White House vision as well?

MR. KALIL: I think clearly one opportunity that we have in the technology area that we don't have in other areas is that particularly if you're talking about the software and the content and the applications, it really is something that can scale. So, a lot of things cost, you know, X-thousand dollars per person that you're trying to reach. And clearly what we see in the digital era is the ability to scale very rapidly with low marginal costs. That's why you can see startups go from 0 users to 80 million users in a very short period of time.

So, I think we certainly have to have a discussion about how we get the

upfront investment in research and development and product development that is going to lead to some of these transformational learning outcomes. And that's why I think looking at the demand side is so important.

It's something that could happen from, as Aneesh was saying, coalitions of the willing. So, imagine if 10 urban school districts got together or 5 states or 10 virtual high schools, and, again, said to the private sector this is what we want. This is -- we'd be willing to pay for a next generation learning environment that delivered the following outcomes.

MR. WEST: Right there, there's a question. On the aisle.

MR. NIEDEL: Mark Niedel. I wanted to follow up with Terry on what's blocking progress. Jim mentioned that performance doesn't generate results. Because Stacey mentioned some excellent ideas. Suppose I as a parent see that. I'm wondering social media are going to allow parents to go around the current administrators and teachers to organize and demand of either the school board or the mayor, saying, hey. We see this Houston experiment, we want it here. And we're going to organize and we're going to demand that you bring it here, or else we don't elect you. Is that a possibility? Is that?

MR. MOE: Yeah, I think it's a possibility. I also think it's really important. I mean, the more pressure there is on the demand side from families, the more likely these things are to happen. And I think the demand is going to go through the roof.

However, on the other side school board members are often beholden to teachers' unions, right? Because they're elected, right? And guess who's active and involved in the school board elections, right? So, they're under heavy pressure to think about jobs and to think about money. And the same is true at the state level.

So, you're fighting against a power structure that is truly awesome, right?

MR. NIEDEL: Do you think the social media are following the barriers for parents to organize so that there's really the possibility --

MR. MOE: Yes. Yes, I do. But you still have to recognize -- see, I'd want to encourage that. I think this is fantastic. But you have to recognize that this power structure that you're up against is massive. The teachers' unions have 5 million members nationwide. You know, multiply that by \$600 a year and you're talking about billions of dollars that they have to spend. And they are enormously powerful in this process. And if they want to keep a lid on it, you know, you've got a big mountain to climb in trying to get districts and states to loosen up and actually authorize schools, enroll more students, and really let this thing go. Because so far it hasn't been unleashed.

MR. WEST: Okay, Karen, do you want to jump in there?

MS. CATOR: Yeah, I just actually wanted to respond to one thing. I actually don't think we need to set it up as kind of technology or teachers. I think that's absolutely -- I understand why you're saying that and I understand maybe it's, you know -- but I know so many teachers, endless numbers of teachers, who are absolutely wanting to power up their classroom. So, I don't think that it's an us or them, or it's a teachers or technology. It is making teachers much more effective by making sure every single student has those resources in their hands every single day.

So I think that we don't need to get into the -- a power struggle. I also know the school board's association, they host site visits to schools that are already powered up. And so there is actually a growing movement, and I think one of the things that we can do to help people who are uncomfortable with the conversation, build huge transparency. Get those schools out in the open, make videos, make -- tell stories. Show what it looks like to have a classroom where students are leaning forward, they're

engaged, they're involved, they're thinking, they're interacting with others. And so I think that that's a huge part of our solution as well.

MR. WEST: Let's take a couple more questions simultaneously, then we'll give our panel a chance to respond. On the aisle there?

MS. KLEIN: Hi. Andrea Klein with the Total Family Care Coalition. I'm all for technology. I really think that we should be going down the broadband route. But my concern is how are we going to incorporate the educational aspirations with what are the business needs? Where are we as a nation looking for to be competitive globally? And what is us as a nation -- what are the industries going to be for the future so that we can prepare not just our kids, but those that have been displaced?

MR. WEST: Okay. Good question, let's take one more. We'll take one more question and then give our panel a chance to respond. Yeah, right there.

MR. MARTINEZ: Jaime Martinez, Department of Energy. I was impressed by Mr. Moe's reference to disruptive innovation in schools. It's probably the more enlightened comment I've heard in a series of -- such of the conferences I've attended last year.

In any case, I wondered where the preparation of teachers by the various institutions of higher learning comes into this picture in terms of making an eventual change in the system.

MR. WEST: Okay Stacey, do you want to take the first question?

MS. CHILDRESS: I'd rather take the last question, if that's all right.

(Laughter)

MR. WEST: Okay, take the last question.

MS. CHILDRESS: Having spent some time at a university. So, the ed school question is an interesting one. The teacher prep question. Clearly, it would be

preferable for teacher education programs to kind of get religion about this new way of powering up their classrooms and have kind of waves of new cohorts of new teachers who probably themselves at their very young age are digital natives and have grown up just kind of immersed in technology. And I think it's not a goal that is impossible.

But what I would say about it and what I say when I'm asked is, don't we have to wait until the ed schools kind of retool to prepare teachers to teach this way before we make a massive move? And forgive the snarkiness of the comment but, our ed schools aren't preparing teachers today to teach in the environments we're asking them to go in and teach in. So it's not as if we've got a system that's performing wonderfully preparing teachers to teach in analog classrooms, and that we have to wait for them to get religion on the digital classroom. It doesn't work now.

And so, would it be great if it worked? Yes. But I don't think it's a gating factor on the rapidity with which we're all prepared to move to transform the way classrooms work.

MS. CATOR: Yeah, sure. I can jump in and actually to the first question, I think that the answer is, we don't know. We don't know what the jobs of the future will be, so we absolutely have to make sure that kids are learning how to learn every single day. So it's enjoying the day as it is today, and it's also preparing students to continue to learn. So that's the first answer.

On the teacher front. You know, one thing is interesting. If you look at the demographics of those people who play games on Facebook, like the Zynga games. You know, *Farmville* and such? It's actually something like 55-year-old women or middle-aged women. This whole conversation about teachers and technology I find interesting because I do think we just need to remember that teachers are college-educated, teachers are learners, teachers actually want to do the very best for their

students every single day. So, I think what we've had is a situation where they've been trying to buoy up this print-based classroom at the same time kind of bringing in some things in the back; it's a very unwieldy situation in a classroom.

So when we actually can make this transition from a print-based classroom to a digital learning environment, within the structures of classrooms and teachers and adults and kids and interactions, then I think it's going to actually become a lot easier for teachers to be trained and understand how to manage an environment where students are actually kind of online and powered up.

MR. MOE: I'd like to make one comment on the teacher side. You know, technology is not anti-teacher. And I certainly didn't mean to imply that. I think technology does empower teachers; it does make teachers a great deal more productive. And it is going to lead, ultimately, to their playing a variety of differentiated roles that are very different and much more exciting, right, than a lot of the things that they do now. Right? So this is a huge plus for teachers. It's just that we won't need as many teachers, right?

There is going to be a massive substitution of technology for labor over the long haul that I think this is a very good thing. Teachers are going to play a critical role, still, in the whole system. But there won't be as many of them per student. And that is the sticking point. Not that it doesn't empower teachers, it does. It's just that there won't be as many teachers per student.

MR. WEST: Okay. I want to thank Karen and Tom and Terry and Stacey for sharing their thoughts with us. So please join me in expressing our thanks to them. (Applause)

MR. WEST: And for our next panel on the state of educational research and development, I'd like to invite my colleague, Allan Friedman, to come up and



moderate that panel, along with Dan, Brett, and Bror.

Allan is a new fellow in governance studies at Brookings, and he's also the research director of our Center for Technology Innovation.

MR. FRIEDMAN: Thank you, Darrell.

Now, we talked a lot today about the importance of some new ideas, and we're very fortunate to have a panel here that has been very active in exploring and pushing the boundaries of what these new ideas are.

So, Jim mentioned the fact that we don't spend nearly enough on R&D, and certainly if we promoted more R&D and it was of the quality that this panel can promote, we'd make astounding progress by leaps and bounds.

We have some representatives from the academic research side, the private sector side, and the government and defense community, and I'm just going to briefly introduce the panel, and then we'll talk a little bit about some of the work that you've each been doing and then maybe move the conversation to a more general question of some of the hurdles and challenges of educational R&D.

So, starting with Brett, who is the program director in social psychology at the National Science Foundation, and before that he was faculty at UCLA and then SUNY Buffalo, and then he's also worked as a researcher for a Gallup organization and has done some work on self-concept and self-evaluation and self-regulation.

So, Bror is -- the full title is chief learning officer at Kaplan, and before that he has been extensively involved in a wide range of educational technology firms, including K12, Inc., Knowledge Universe, and before that he was in the private sector. He also knows a great deal about education having two bachelor's degrees, a master's in mathematics, a Ph.D., and an M.D. So, someone who knows a lot about education from all sides.

And, finally, we have Dan Kaufman, who is at DARPA as the director of Information Processing Techniques Office. He's also the director of the Information Innovation Office, and prior to that he spent some time at DARPA developing computer games that allow soldiers to rapidly understand their deployment. And he's also worked with In-Q-Tel helping work at the CIA and has also spent extensive time in the private sector both in game development and in entertainment in general and before that was a lawyer in the high-tech sector.

MR. KAUFMAN: Awesome.

MR. FRIEDMAN: So, Brett, I was wondering if you could tell us a little about some of the work that's going on at the NSF and some current trends.

MR. PELHAM: Sure, I'll tell you about at least some -- a little bit of my own work and some work in my field that may sound a little far afield from the kinds of things folks have talked about today but I think are very relevant to the complicated picture of education, especially in a very culturally averse nation like the U.S.

Let me just give you a few quick findings. I'm going to give you a sentence or two about entire research programs, so I'll try to go quickly.

Asian-American girls and women who are asked to check off their ethnicity before they take the SAT or an SAT-like test do better than Asian-American girls and women who are asked to check of their gender. So, if I suddenly remind you that you're Asian-American as opposed to suddenly reminding you that you're female, you do better especially on mathematics tests.

Okay, what's the basis for that? Well, there's a very profound social basis then, things like stereotypes. If a teacher, for any reason -- your ethnicity, the brother who's a troublemaker who came before you, the fact that your gender is female as opposed to male -- has an expectancy about you, especially in the early years of

school, that unconscious expectancy, not an ill desire on the part of the teacher, has a powerful effect on your performance throughout the school year. So, if teachers think that you're bright and you're going to do well, you probably are going to do well. If they think you're not so bright, you're not going to do so well, or maybe you are bright but you're a troublemaker, you're not going to do so well over the course of the year.

If you take white males in college -- Jeff Stone has done these very studies -- and you tell them I'm giving you a test to your sports intelligence. It's a putting skills test. You have them do that exam and you tell them it's a test of sports intelligence, they do substantially better than if you tell them it's a measure of their raw athletic ability. African-American children, the reverse trend. If you tell them it's sports intelligence, they do worse; if it's raw athletic ability, they do better. Exactly the same skills, exactly the same task, framed a little bit differently that are stereotyped consistent versus stereotyped consistent and you see radically different performances.

One more example in the form of the case study that is based on research, my seven-year-old son was forced by me -- I don't know, I was in an evil mood the other day, about a month ago, actually -- to watch *Dora, the Explorer* with my two-year-old daughter. I wanted them to have some time together and I was cooking and so, you know, why don't you do this. I can hear my son to Dora saying what did you like? And he says chewing up razor blades. And what does Dora say? I like that one, too. And of course my two-year-old daughter is hearing this and I run in there and intervene, but the point is Dora's not a very responsive teacher. She's cute, she's cuddly, she has fun things to do, but she says everything is right. No matter what you say, she likes it, too.

Well, Pat Kuhl has done a lot of research at the Life Science Center at the University of Washington that show that kids don't learn much in situations like Dora,

because Dora is not responsive. She says the right things. She always gets her addition right, but she doesn't respond to the cues that you're me as a learner about what the right answer is and what the wrong answer is.

So, these are three or four quick examples. I could give you dozens more in my research area and other research areas that show that learning is an inherently social process. Kids learn from teachers, from their parents.

Another quick finding. Twenty-two years ago in graduate school, I learned about the study in a course in gender that somebody had finally claimed to show -- you know, we've been trying to show this for centuries, because, you know, men have to be better than women at certain things -- somebody claimed to have finally shown that men are better at the extremes of math. So, math, you know, especially in the lower grades, girls do just as well, maybe better at math as boys; but if you look for the truth mathematical geniuses, it was argued, there are way more boys than women. So, teachers gave the math SAT to I think sixth- and seventh-graders, and they found that boys were 10 times more likely than girls to score at the extremely high level. And they said look, this is not even being taught in school; it's obviously not a schooling -- now there are more boy idiots, too, was their argument, but there are also more boys who are geniuses; we've got to pay attention to this and find those geniuses and train them. Well, it took about 10 years for somebody to do a follow-up study that said well, that is the case, we replicated that finding, there are more boys who do really, really well and really, really poorly on math even on a test that you'd think they've never seen before until you step outside the classroom and see what's happening at home. As it turns out, parents about 10 times more likely, when they see that their son is really good at math, to spend time at home working on math with them. And when a daughter shows the same aptitude, parents are way less likely to pull her aside at home and spend that extra time

with her.

So, I'm giving you examples of successes and failures in the social sciences that show very clearly how complicated this picture is. And when people ask me why I work at the National Science Foundation as opposed to other jobs that I've done, I say that one of the goals I have is to bring the science of social behavior to the world, to teach the world that most of the problems we face today -- including educational -- problems with the educational system -- obesity, aggression -- those are social problems. We're not going to solve those problems by inventing better fMRI machines or better systems for surveillance. We're going to solve those problems by understanding human social behavior in a social context, and I would argue that education is a great example of how we need to do that.

I would also argue, unfortunately, that the situation is sufficiently complicated that there's not just one solution. So, when I teach my students -- used to be at UCLA, more recently at UB -- about the causes of stereotypes, and I tell them what we can do, I say I have bad news for you. We stereotype each other for a dozen or more really well-validated reasons. That means it's really hard to change stereotypes. If you want to change gender stereotypes, there are a dozen different reasons why they exist. I don't mean little reasons; I mean big reasons.

And so the challenges teachers face are social challenges, and of course one of those social changes is the digital divide. We develop amazing sources of technology, and the kids in Bethesda -- there where my son's lucky enough to go to school, not because I live there but because his mom does -- those kids don't have problems with technology. They don't have problems with teachers who are there prepared and ready. But my nephew, who lives in a trailer park in rural Georgia -- he does have that problem. There isn't a computer in his school. His teachers have

difficulty keeping the kids awake, because some of them don't get much sleep at night and don't get breakfast in the morning. So, we have very different problems for different groups of kids.

So, if you look at PISA scores -- if you look at the PISA scores of middle-class American kids and upper-class American kids, I'm sure we do very, very well. If the PISA scores of those kids in rural and often inner-city ghetto schools who are not doing so well is because they don't have access to basic resources -- not just a lack of access to technology but to basic resources.

So, I realize I'm jumping around a lot, but the general point I want to make is that this problem is a very real problem, but it's a very real problem that requires social solutions as well as technological solutions.

MR. FRIEDMAN: Thanks.

So, Bror, some perspectives from the private sector?

MR. SAXBERG: Sure. I'm the chief learning officer of Kaplan, and so I look across all the different business units that Kaplan has. Kaplan has more than a million students a year worldwide that we teach ranging from tutoring mathematics for six-year-olds and seven-year-olds on up to high school students of various kinds -- test prep -- I won't ask you to raise your hand if you've been to a Kaplan course -- and on up through certificates, diplomas, all kinds of postsecondary bachelor's degrees, master's degrees, and on out to continuing education. So, we really do run from ages 6 to 90, basically, around the world. And my charter is to look across all this and coordinate the underpinnings of learning for all the different business units so that we move toward a common understanding of how learning works and that we begin to benefit from having more than a million students a year.

Learning and technology, technology and learning -- it's interesting. You

know, technology is fairly recently. My kids like to torture me by speculating on which came first, the wheel or Dad's first computer. And yet, learning has been around a long time.

I am the grandson of an illiterate truck driver. It's not as if humanity has been unable to learn, right? There are some examples of extraordinary movements in learning over time. The challenge is how do we scale this up so that it's not just .1 percent or less who are able to make some kind of extraordinary movements and how do we increase the pace. And this is part of what we're engaged in across Kaplan.

The way I think about this, probably because of my own M.D./Ph.D. work as a research guy in the cognitive science world, AI world, many years ago, is you have to figure out your learning problems first. It's the learning science that has to come first. What is the learning problem? And this actually is true for technology as a whole. Technology actually never solves a problem. Technology can take a really bad solution and make it work really quickly, right? And it can take a really good solution and make it work incredibly efficiently and quickly as well. But notice you have to have the solution first, and then technology completely changes the dynamics, the scalability, the cost, the reliability, the way data flows and allows you to innovate, et cetera.

So, several things around the learning side that we are doing that we then think technology will really help us. One of them is making expertise visible. There's actually a whole science around what experts are like, and it turns out it's not what you might expect.

Seventy percent or more of what makes experts experts is actually subconscious: subconscious capabilities of pattern recognition, complex procedures. For example, I'm going to ask you a question. How many of you drive a car? Raise your hand if you drive a car. Okay, that many people are awake. That's terrific. (Laughter)

How -- oh, sorry. Now, how many of you have had this happen to you? You start out driving to place A, then you're thinking about your job or your work or this meeting and you look up and you're at place B. Raise your hand. Has that ever happened to you? Look around. Look around. Right? Lots of people are raising their hands, right?

Who drove you to place B? You know, where did they come from? You were thinking about something else. Were they in the car when you were 16 and the state trooper, right? So, this is common to all expertise, that there are patterns that exist that subconsciously become fluent.

There are techniques from cognizant science called cognizant task analysis that let you make the invisible parts of expertise become visible, so we're now doing pilots in various of our programs within Kaplan to actually do that and then tie that into instruction, because research shows you can cut the time of mastery by 20 or 30 percent or more, and you can have students who graduate from those programs who essentially make no mistakes. It's actually quite extraordinary, the results of that. So, we were working on that kind of thing.

The second major area that we're looking at the learning science and then using technology to enhance things is optimizing education. And you've heard a lot about that already today. One of the areas is just data. We're collecting data on a hundred thousand of our -- 90,000 of our students as they perform and using that then to evaluate how the courses are working so that we can then target investment into fixing pieces and whole courses using technology. That kind of data has allowed us to see that when we add some adaptive technologies to some of the math courses, we've had extraordinary gains in the retention of students in fundamental math courses. And in postsecondary work, our student populations are very high risk, so this is a big deal to be



able to help keep them in.

We also are building out a kind of concept car where it's a, you know, kind of an extreme sports version of electronic education, just like automobile companies make concept cars? You know, they're usually not street legal in Iowa, so I don't think this course will be street legal in Iowa, but it's going to illustrate as many of the cognitive science principles as we can dig our hands on with real data behind them around knowledge -- advancing knowledge, how screens affect learning behavior; how do you diagnose and understand motivation from some of the motivation theory work; and how do you enhance meta cognition, the understanding of how learning is progressing so that students build their skills for learning as well as they build their specific domain skills.

So, the final thing we're working on -- and I think the whole industry needs -- is faster pilots. We've heard about scale and the need to do this faster. We have a facility with our own test prep unit that can do randomized control trials online very quickly, so we did one of them -- 900 students -- in about 4 weeks looking to see whether video helped or hindered learning and were able to use that to change how we were developing programs. Well, okay, so we're a big company or whatever, but, my goodness, there's 50 million in the U.S. I mean, how many of those experiences are we actually learning from? Nearly none. I mean, it's not .1 percent of budget. It's almost -- it's essentially 0 percent of students from whom we're learning. So, we need to set up better facilities for doing pilots quickly and well I think.

You know, ultimately, we as a large company -- where are the cogitech companies, right? The biotech industry is filled with little strange companies coming out of a wish and a prayer from universities. Most of them fail after trying for a few years. But where is the cogitech industry that a large place like us can say whoa, I want that, that's great, let's scale it up, let's go. And I think that gets to the demand issues people

have been talking about this morning, which I thought was really smart, that -- you know, we have demand. We have an appetite to increase learning, and it really helps us, so we want that to happen. But in the marketplace, boy, there's not so much of that demand to be able to plug into. So, ideas about how to do that I think are very -- a big deal so that you can get more innovations and uses of technologies that drive learning that and that what comes, you know, to market can actually be deployed at scale, because it's very hard to do this work by, you know, the tens of thousands. And that becomes a key part of what you want to incent people to, to innovate.

But those are the few things that we're trying to do within Kaplan.

MR. FRIEDMAN: Thank you.

Dan, you want to talk about some of the cool toys you've been building?

MR. KAUFMAN: Okay. Yeah, it's sort of the most fun thing at DARPA I write, because I came out of the commercial world with the DreamWorks and Microsoft and, you know, you have to deliver ever quarter and at DARPA they give you the freedom to just be a little crazy, which somehow fits me, so I'm going to touch real briefly on a few things we're doing. If anybody's interested, we can follow up more but just give you a taste of them.

One thing that -- I've heard a lot about digital tutors. We have a big digital tutor program going out. Just to give you an idea, we've done it -- we took a bunch of Navy freshmen basically that never had any IT training whatsoever, brought them in, brought them through the digital tutor course, and they have consistently out-performed people not only who have graduated the course but have five years worth of experience. So now, whether that expands beyond IT, I don't know, right? But it's pretty cool.

Another thing we're doing but to just give you the idea of breadth, we're looking at neuroscience in a really, really deep way. We were actually funded some

research that actually is looking at saturation levels. In other words, could -- I could hook up an FMRI to your head and figure out, you know, when should I stop studying? I have a son who's a freshman in college. I think he would love to know that. You know, when did you hit that burned out level. You know, you've just studied enough and you should just take a break. There's a way to optimize that, so we're looking at things like that all the way down to are there ways -- you know, we take Gatorade or we can take oxygen to improve performance. Could I make a student more ready to learn -- right? -- not modifying things but just stimulate that, think about the brain as a muscle.

Other things we're looking at -- I have a simulation program that we put out to a lot of the schools. We're letting a lot of the kids build a -- to make it as easy as you use Word or PowerPoint -- to be able to build a simulation with all the physics. And what I like about that, as I call it, learning is a Trojan horse, right? So, you're just out there having fun. You can build any video game you want. But in order to do it, you have to start to actually understand the logic of programming, understand the math. But I'm not teaching any of that. You've just decided you need to learn that, right?

Another thing we heard a lot about on the buy side -- we have a program out called transformative apps, which says -- look, I can't reform the acquisition process, I tried, you know, it's not going to happen. But what if you end run it. So imagine that I could give -- instead of trying to convince people to change I gave all the soldiers virtual dollars and instead of paying for them -- instead of them paying to buy an application I'm going to reward based on usage, right? So, I don't want to pay \$50 million to develop a language translator. I'll let the market decide it. I'll give 50 million bucks to the one that everybody likes, right? So, pay for what I want, not for doing it.

So, we have a lot of different things like that. The newest one we kicked off is something called Engage -- doing it up with University of Washington and some

other places -- that I think is really neat. The idea of moving from a theory-driven method of learning, which -- and there's tremendous value in it, right? I want to be clear. But to a data-drive one. I did a program called FoldIt in my tour at DARPA where got 13-year-old kids to compete in biotechnology tournaments against PhDs and supercomputers, which was just really fun if no other reason than that, and we finished third. So, it wasn't so bad.

Questions -- could you apply that to education? Can I do that algebra and fractions, you know? And by data-driven what I mean is imagine a merchant learning coming up so that I have thousands of kids and there -- I'm watching the way they learn and I'm changing what they learn based on what they're actually doing. So, there doesn't have to be a right theory. I can watch them.

And imagine that I can tap into the power of a crowd source in the social networks where the kids become the tutors themselves, right? Think about it. They're closer to understanding the breakthrough than any teacher possibly can be, because they just did it, right? They know what worked for them, and you can imagine groups coming along on this. So, we're pretty -- I'm pretty excited about that stuff and being able to track it and change it in real time.

So, this came about because one of our performers has a little girl, and, you know, he heard all the horror stories that I hear today, which just terrifies me that, you know, they all fail out and they're never going to do anything, and, you know -- and so he went and he said not my little princess -- right? -- no, not going to happen. So, he went to the first school and he said how do you teach fractions? It seemed a very reasonable question. And they said, oh, because we teach a half a quarter, an eighth, a sixteenth. And he said, well, gee, that makes perfect sense, felt comfortable, went to the next school and just asked, curious, and it was like his control question. And they said,

oh, we teach a half, a third, a fourth, a fifth, a sixth. And he said well, wait, I thought you were supposed to do a half, a quarter. They said oh, no, no, no. See, that's much easier and they learn faster, but they don't really understand the abstraction level; you need to learn a half, a quarter, a fifth. He went, oh, okay, well, I guess that sort of makes sense. And he went to a third school, said oh, no, no, that's completely ridiculous, we use manipulables. So the key is you've got to put down pizza pies and they divide it up. And he said, oh, my god, we don't know. (Laughter) And he didn't know what to do. And the thought was maybe I could drive it to this data driven and maybe there is no one answer but I could build a platform to do that.

And then I'll leave you at the end. This is a story our director tells, but I really love it. Somebody asked me a while ago don't you get depressed, because you look at this huge number of things. We've heard everything wrong, right? Buying problems and frameworks and teachers and unions and just all sorts of stuff, and so she tells this story about an author, famous author who every morning to clear his head used to walk along the beach. And one day he sees a young girl dancing on the beach and it's just -- you know, it's enthralling. It's entrancing to watch this little girl. He gets closer, he watches her, and he realizes that she's not dancing at all. She's bending over and picking up starfish and chucking them back into the ocean. And he watches for a little while and then he can't help himself, He walks up to her, he says, little girl, don't you understand there are thousands of miles of this beach and there's thousands and thousands of starfish, and you can't possibly get them all back in the ocean? You can't make a difference. But she looks at him like little girls do, you know, flips her hair up and says, well, made a difference to this one.

And I guess to me that's sort of my take. So, yes, we have a lot of things to do. We have a lot of programs here at DARPA. I've heard about a lot of good things.

But it's all just about one, you know? And for me that's the core.

MR. FRIEDMAN: Excellent. So, quick question playing off that, and this would be to all three of you. How do we reach that one? How do we have --?

MR. KAUFMAN: Play basketball. (Laughter)

MR. FRIEDMAN: Well, thank you, Dan.

MR. KAUFMAN: Maybe it's something I said. (Laughter)

MR. FRIEDMAN: That'll teach you to take her joke.

Well, so, how do we reach out and make sure that that one is the important one and this is sort of a diffusion-of-innovation question, because we've talked a little bit today about scale and there's scale on the technology design, making it available, accessible. But also there's scale on the political side, and there's scale on the social side of actually making it useful to each student because we've also discussed that, you know, everyone really is an individual. So, can you talk about how we take some of these fresh ideas and roll them out in such a way that, you know, we can actually get them widely distributed.

MR. SAXBERG: Well, one way is, you know, the kinds of innovative models that have already been talked about -- and being in the private sector myself that's part of what we're doing -- is we're trying to offer, directly out to people who want to learn, systems that want to try something new, ideas that we can scale up and aggregate various kinds of demand together.

The other thing, though, about that is, you know, the personalization aspect I think is incredibly important; too, so that people start to feel like organizations, systems really know them. And it turns out, there's learning science behind this, too, that as you create learning experiences that are challenging but not too challenging that take advantage of what's already in long-term memory so that you're not forcing working

memory to get too overloaded, learning gets more interesting. It actually is really pleasurable, unlike how a lot of our systems that are more cookie cutter make people feel about learning. So, by personalizing the learning and making it clear you are doing that and that you can repeat doing that, you are actually welcoming people to come back. And I think, as people know from mega trends and other things we heard here today as well, with this acceleration of career destructions and creation, you know, where do you go to get advice, you know?

I started life going to college wanting to build stereo equipment. You know, my mom and dad weren't setting me up to be a chief learning officer, you know 30 years ago, and I've been a managing consultant myself. I've been a research scientist. I've been involved with other companies around learning and, you know, how -- you know, we need better tools to help personalize my next transition -- right? -- so that it would take account of the fact that, yeah, I know research, I know M.D.'s, but I'm not really an English person at all. So how should that affect what I do? And once I started to get confidence about that, I'll actually start accessing tools more, because I'll know that I can go there and get change. So, I think it's a combination of the demand side of getting folks to buy these things and work with them and bring them out, but I think it's also a customer experience side, a learner experience side. Once you start to be able to trust that environments will be engaging and successful, you'll come to them sooner I think.

MR. PELHAM: I think that's a great answer. The great thing about a question like that is there's many different answers. My answer would come from a different perspective.

I come from a family of a few teachers, a family of, you know, parents who didn't even finish high school but of whom my siblings -- the six of us -- three of us

are involved in some way in teaching, and one of my brothers just became a principal. And he told me a story about a kid he had in his class last year, the first year he was a principal, who just wasn't coming to school, and he couldn't find out why. He tried to get to the bottom of it. He learned eventually that the kid's mother just wasn't bringing him to school. She had some drug issues and other issues. So, what he told her he was going to -- and did for about two straight weeks -- was go to his house every morning and knock on the door until she brought him to the door. And needless to say she became very irate and then she moved to a different school system. (Laughter) But in that -- the rest of that academic year, that kid was at school every single day, because eventually she learned, yeah, you'll come the first day; you're not going to be here tomorrow. He was there tomorrow. He was the next day.

So, what I'm saying is it comes down to teachers. So, I agree with the things that were said about unions, that often these things are politicized and there are barriers, but I think most teachers work really hard to be good teachers, care deeply about learning. And so they are the ones who can really personalize learning.

Parents, of course, also play a huge role in doing that. So, if you want to know how to personalize things, you take what we know about learning and student engagement and things like that, and teachers and parents apply that.

So, for example, Gallup, where I worked for a couple of years, knows a lot about how to motivate employees, and they're now applying some of that to how to motivate students. And one of the things that you do is you identify people's unique strengths. They have a list of 34 of them. Everybody has some. Some have more than others. Everybody has some things that they feel really good at and are confident doing, and so teachers and educators and parents intuitively often learn that and do that, but of course Gallup gives people a formal way to do it.



You can test people and say these are your five signature strengths, and if a teacher knows that about a student, it gives them an ability to communicate with that student at a more personal level, challenge that student in ways that they wouldn't otherwise do it. So, I think there's tons of knowledge out there.

Bob Sternberg's work on how different people learn in different ways, college professors at least have applied that. So, there's a lot of work about how people learn, and I'll use this as a chance to mention one other program that I'm a part of at NSF, which is the cyber learning solicitation that came out, I believe, in early October. So, if you're a researcher here who studies education, they're particularly interested in solicitations for new research proposals that have to do with using technology to improve the education process, especially in ways that personalize learning. So, in other words, software programs or computer programs of any kind -- I say wow, this kid is really good at this, let me push that.

So, you know, if we have technology -- when I go to Amazon.com, it says people who like that book also like this book? (Laughter) You know, Amazon's great at that. They -- it's like, hey, I did like that book, that's great, how'd they know that? Because eight other million people who bought that book also bought the other book. So, if we have that kind of technology readily available in the marketing community, why can't we do things like that with learners and apply that technology, say wow, kids who are good at this task often enjoyed this task and get engaged in that task. And, of course, teachers do that at an informal level, but, you know, my basic answer comes back to it's up to teachers and parents to do that, and technology can enable them to do that even better.

MR. SAXBERG: Interesting comments and spark a couple of thoughts. On is another plug for the McKinsey Report that came out earlier. One of the things that

look at exactly as Jim was saying is these stages of learning of the most improved school systems around the world -- what do they actually do? One of the things that applies at several of those levels is to provide teachers with support based on the differentiation of their students so that, you know, it's like teachers are your general practitioners but that they have access to specialist tools, programs, and other things that they are able to guide and control. So, you don't want your teachers to be left alone with a huge variety of problems and challenges. You want them to be trained and have available to them tools to do this.

And you just mentioned that idea of using technology to enhance that. We've heard several ideas like that. Within Kaplan, as well, we're piloting where we have an adaptive homework engine that students are working on the night before, and then that homework engine actually feeds to the teacher the next day a suggestion for how to group the students into three different kinds of activities where the scaffolding and the type of the learning is different for those three. And that way, the teacher gets guidance based on homework from last night and the trajectory of learning in the past to have suggestions about how that should link to the exact activity that's coming that next day. And, you know, if you're teaching for one type of thing or another type of thing, the groups just start moving around, and it's driven by data to guide the teacher.

Now, teachers know more than data, so they can do what they like in terms of where the students go, but it gives them a first cut at what the data suggests you might want to do as a subgroup, and I think that's all part of giving teachers, you know, better tools to customize and personalize their instruction, which will make it more compelling, and students and parents will feel like maybe I don't need to start reaching completely outside, now this environment really knows my student. He comes home engaged or she comes home engaged and excited because there's been a matching to

that student's capabilities and progress that's dynamic, not stereotypical.

So, I think there's a lot that can be done on that front. There's no question.

MR. FRIEDMAN: Sure. So, I can think we can open it up for some questions from the audience if -- one over on the side there.

MR. MOORE: Travis Moore with Congressman Waxman. What would you all like to see come out of ESEA reauthorization, especially from the technology side?

MR. SAXBERG: Oddly, you know, in some ways I think the most important things that can come out of a lot of these policy and government decisions are likely to be less about technology than about learning, than about focusing deeply on really effective standards, which now look like they're in place for K-12, but I would say for higher education as well -- you know, where the government-funded cognizant task analyses of different key professions so that all the rest of us can start competing against how do we deliver those. I mean, we're having to do them, because nobody is doing them, but that would be a great standardized thing to look at, you know, the best performance and create standards for careers and professions as well as for the K-12 space.

And then the data ideas -- you know, the notion of not being scared to make data transparent and perhaps through policies push it, really start to talk about you need to make data available and transparent as part of decision-making and have that be a component of that. So, to me it's not so much technology as it is more about learning and transparent information that are the key things to come out of this, but I -- Bret, your thoughts on --

MR. PELHAM: I don't have expertise in policy enough to answer, so I

would trust your answer. (Laughter)

MR. FRIEDMAN: Other questions? There's -- in the middle there on the aisle?

MS. KLEIN: Hi, Andrea Klein with the Total Family Care Coalition. With regard to research and development and allocating funds for it, what do you think would be a good formula with regard to government dollars, foundation, philanthropic dollars, industry dollars, and then the role of nonprofits supporting in their area of specialty?

MR. SAXBERG: Shall I take it -- start?

MR. FRIEDMAN: Go ahead.

MR. SAXBERG: I'll start, sure. I'm M.D./Ph.D., so I look at education with kind of double-vision, and so I think about the health care model and I think there's a lot to offer from the progress of that industry over 70 years as it's developed various mechanisms, and even the whole intellectual property issues are really important if you want to galvanize both the research community and the business community to actually get the real implementation.

It's pretty clear the first answer is "more" -- I mean, 0.1 percent. One of the telling aspects of this is education companies don't even bother to report R&D in their accounting statements. I mean, so many industries actually have an R&D line. Education companies don't even think there's a reason to talk about it. Think how extraordinary that is. We've built an industry that doesn't appear to be where it's worth telling the financial community about R&D in some ways, and so I think that that reflects, you know, a miss about how important R&D is.

And, you know, it's probably that you would like to have seed fund for the longest term projects to come out of the federal government. That's been the standard in many other areas, and then you know, keep working -- you're way down to the most

dollars possibly being in the real implementation work, the real "D" work that gets you final products that come out.

Your thoughts?

MR. PELHAM: I'll give you an answer that reveals my ignorance about education in general but also the fact that I am a social scientist and I'm a statistician, so what little work I did at Gallup on education -- I was always the stats guy and the social science guy, not knowing much at all about how education works, so I learned what PISA scores are and that sort of thing.

But in some of the modeling I did for folks at Gallup I kept seeing this outlier -- and it was Finland, by the way. I was like, huh, Finland keeps doing really well, wonder why. So, I did -- I had no idea why. Well, I did discover one of the reasons why Finland does better than us -- I think one possible reason. You know, obviously these are not longitudinal studies and we can't draw a firm and causal conclusion, but one of the things I saw in my own data was that they have really high computer penetration rates, and I learned by analyzing the data cross-nationally that that's just as important as GDP.

It's really good to be a rich country. Your kids do better on the PISA. But it's just as important as being wealthy to have people using computers a lot. I don't think a computer's a panacea; I think probably a computer's a proxy for education matters in this country. We're all intellectuals. We think about things, and so one of my hunches about what was happening with Finland after talking to real education experts was in Finland education's free. From the very beginning at kindergarten through medical school, anybody who's willing to put the work in can go to college and to graduate school and medical school or law school in Finland. We obviously don't have that model here. I would love to see that model here. There are all kinds of political

battles that would have to happen before that model could ever -- would ever reach that model, but to me that's the ideal world. Everybody who's willing to put the work in can go to any kind of school they want to go to. And so when you see nations like Finland that are outliers because they keep doing better -- their GEP's not that great; we're way wealthier than they are, but they do really well in school because I think they really value school -- and there's such an enormous value in education that they got. Some wise government person many years ago made the decision to make it truly available to everybody.

MR. FRIEDMAN: We've got a question in the front in the middle here.

MR. LORD: Thank you. Dale Lord from Senator Rockefeller's office.

I appreciated your reminder, Brett, about the inherent social nature of really the problems we're discussing here. And I wonder, you know, you hinted at the stereotypes -- if you could, and you can probably jump in, too -- the role of technology in addressing those stereotypes, of amplifying those stereotypes sometimes.

MR. PELHAM: Sure, I'll start. I mean, it's a great -- but I think part of -- one of the interesting interfaces of what's social and what's technological is it's not so cool to be a techie if you're an ethnic minority, for example. It's okay to be a geek if you're a white kid in Bethesda. You can find ways to get away with it. But there are powerful social forces that are very, very stereotype consistent -- what girls are supposed to do; what's cool if you're a black versus what's cool if you're white -- that really reinforces the status quo. And it's so pervasive that we, ourselves -- you know, I study stereotypes and I catch myself, oh, my god, that was a stereotype. I just stereotyped that person. Was it -- oh, well, no, it was an unconscious stereotype. I don't feel quite as guilty. (Laughter) So, you know, even people who study stereotypes realize how pervasive they are and how powerful they are and how hard it is to change them.

On the other hand, we also know that one of the routes to changing them is behavior: The first, after making any changes to realize that something is true; the second set is to reorganize your life or to get involved in some kind of activity that changes that. So, for example, the stereotypes about African Americans that people show on automatic indicators that you can only get from a computer -- some of these you can only get from an fMRI -- change the minute a likeable, intelligent black guy walks in the room. So if my teacher's an African American, I have that model everyday, I'm getting primed on a daily basis to something that's counter stereotypic.

Now, I still go to the movies that afternoon. I still see that the black guys are usually the bad guys. But -- so, I still live in a social world where stereotypes are part of my experience, but I have some counter-stereotypical experience to make me think about that and challenge that a little bit.

So, it's a great question. It's a tremendous challenge, and I think technology can be used of course to reinforce the stereotypes, or it can be used in creative ways to work against the stereotypes, and we have to look for those ways of counteracting them as opposed to reinforcing them.

MR. SAXBERG: One of the great things about technology is -- you've all seen the *New Yorker* cartoon -- right? -- with the dog and typing at the keyboard? You know, on the Internet, nobody knows you're a dog, right? And, in a way, technology can be very freeing for folks who are willing to engage and, you know, have the skills to do so. There's research about things like discussion groups versus class discussions, and one of the interesting things is, you know, class discussions being so live and in the moment. Folks who actually want to think about things for a second or might not be, you know, the fastest blabbers on the planet end up getting left behind in a way, and their viewpoints are not heard. And teachers -- and I've seen it myself in looking at

classrooms, the teacher thinks the class is doing fine because 20 percent of the people have been participating, right? And so the class has been reduced to the verbal group.

With online discussions that are spaced out in time, especially asynchronous discussion boards, and especially when you have a bit of a requirement to actually post, suddenly there's no compelling reason to post quick. People who are willing to think a little bit about it and look off into space a little bit or honestly who culturally just wouldn't stick their hand up and start yammering in a room full of people with an older teacher at the front. Suddenly it's not about that at all. It's about typing my views into a screen. Now, of course, that requires tape and typing and so forth. But there is this affordance for technology to really change what it is that matters for your education and how you can become engaged. Not a panacea, because there are some who get activated by each other, and so they really want that.

But there again, technology can allow you to have the same learning objectives if they're well designed, even the same kinds of assessment tasks and then multiple different learning environments that can be determined either by you as a learner or by some diagnostics or previous history about -- learners like you seem to do really well in this kind of environment. And you will then master at high rates the same objectives as other types of learners master in other environments. And so that ability to kind of diagnose, to sort, to quickly, inexpensively provide highly reliable and differentiated learning environments I think can go a long way to helping, you know, battle against some of the stereotype issues that are there.

MR. PELHAM: That's a great concrete example. I mean, on the Internet, nobody does know if you're a dog or they don't know if you're black or white; they don't know anything about you unless you choose to reveal it. And it really does free up -- like, anyone who's taught at a university knows, especially at the level of



graduate seminars, it's much more difficult, on average, to get women to speak up than to get men. I have brilliant graduate students at UCLA for 10 years, and I would give them a pep talk at the beginning of a lecture: Regardless of your agenda, regardless of your expertise in this particular area, everybody has to speak up. And there were clear gender differences.

Men, you know it's -- people call it a male answer syndrome or manspeak. Men always have the answer. We know the answer to everything. In fact, I should study -- I've studied -- I've documented this, particularly when you threaten us, by the way. So if you point out something else I don't know, I'll become even more likely to say I have the answer, whereas women will likely -- well, maybe I don't know. So, there are gender differences that are socialized, that are stereotype consistent that are so powerful, that can go out the window if people don't know. If I don't choose to reveal my gender, I probably am not nearly so likely to succumb to those gender stereotypes.

MR. SAXBERG: I'm focusing on something completely different, which is what you want in many cases.

MR. PELHAM: Yeah.

MR. SAXBERG: Yup.

MR. PELHAM: Yeah.

MR. FRIEDMAN: So, I should add that in January we're going to have an event on exactly what people do know about you on the Internet, as a little sneak preview, but not in the educational context.

I think what we'll do is take a last few questions and sort of bash them together. So, there was one right there. Sorry.

MR. PIDEY: Thank you. Bill Pidey with Johns Hopkins University. I want to ask you a question about the infrastructures.

Whether we're talking about systems that help teachers diagnose what's -- how particular students are learning or systems of assessments or standards, we could look at these as infrastructures, and over time what we've learned about infrastructures is they get used and they end up shaping the way that certain activity happens, and I'm wondering what's the research agenda? How do we understand how these infrastructures are going to be built to support all different types of students, different ability levels? What kind of thought goes into the design of these infrastructures for different student types? And once they get deployed, how will we know whether or not they're working and for whom they're working and how?

MR. FRIEDMAN: Okay, great question.

And was there another one over here? Okay, I think -- this one, infrastructure.

MR. SAXBERG: Well, there are -- there's a long-established set of tools and methods for looking, for example, at assessments to understand how well are they working. And all of that I think applies here. It's not done as regularly to some of the formative assessment pieces, the things that teachers use every day. So one of the key things I hope comes out of, you know, the common core work -- and it sounds like it is underway -- is not just, you know, end-of-year, one-shot, record-of-failure type summit of assessments, you know. And we're still not doing it. How about that? Same as last year. Hmm. Instead, the formative assessment, so that they're within the year and frequent enough that you can actually stop and redo something, having those become validated based on looking a lot of data again and replaced if they're not working I think is a powerful part of that infrastructure.

And how will we know it works? Again, when you talk to assessment professionals, it's not one answer. You're always triangulating around these systems of

standards and infrastructures. So, there's the near-term piece, which is, you know, students who do well? Do they do well on these items? There's measures of that. But I would argue there's also the longer-term piece, and sometimes that's really scary where students who appear to do well on certain of our state tests then need remedial math and remedial writing when they get to college. What is that about? I mean, that's a real failure of validity of a set of assessment tools right there. So, it's a triangulation, I think, of near-term results, then results just after the event's over, what happens next and, frankly, longer-term results. And then the feedback, too, about well, what do you wish you'd had. So, it's a triangulation exercise. And it has to apply to the individual, the microscopic assessments and standards and how they're used not just to the big one-shot every year kinds of things. And I think where technology can really help, because you can aggregate that data more quickly. You can make it be a bit more standard -- the item types and data banks of items that the teachers can take.

So, I think there's a lot there that needs to be done and hopefully with the common core things can start to become more commonplace and be worth investing in.

So, I don't know if that --

MR. PELHAM: I would totally agree with that answer, and I would add that -- you know, you asked a great question again. Great questions have many answers, but NSF is sufficiently aware of how important infrastructure is in actually assessing knowledge that for the cyber learning working group that I happen to be on right now, two of the key things they want to see is when you develop this research proposal, it's a study learning and using technology in a novel way. Is it something that everybody can use, or is it expensive and only the elite have access to it? That's a big thing they consider as part of their broader impact. Will this really help everybody?

So, if you're going to do something on Facebook, there are some people

who don't have computers and you've left them out, but a lot of people have access to Facebook.

The digital pen that records what the instructor says as the instructor's talking that I can check on later, that's kind of expensive and not many people are going to have those yet. So, they pay careful attention to that, and they pay really careful attention to what are the learning outcomes, not just the traditional ones, not just SAT scores or achievement tests, but learning outcomes that are maybe, for example, more related to job outcomes. So, they pay careful attention to a multiple set of learning outcomes. And if you -- if anyone out there is doing educational research and you're planning on sending us a proposal, you'd better have multiple educational outcomes if you want to make an argument that this is going to have an educational effect. And ideally, like you said, not just at one time point but at many time points. Maybe it works pretty well for a week or two and then it has no effect whatsoever. What are the long-term consequences, too? Those are great questions that we have to answer to make progress on that sort of question.

MR. SAXBERG: One last thing on that. The assessment battle around common core is the real battle, right? What are the tasks that you mean to use to define the mastery of a brave, brief set of words, right? Because that's the thing that's going to be operationalized, is the assessment results. And so getting those tasks right unlikely to be just being multiple-choice. Otherwise, you'll just have more of the third of year grinding away on multiple-choice tests. You need some rich and complex tasks that closely match what you really intend the skill to mean, and that's a battle royale. That's a major battle, but it's the right one to have. It's the right one to have.

MR. FRIEDMAN: All right, I think that wraps up our time, but I'd like to thank Bror and Brett and Dan who, hopefully, is okay.

And introducing the next panel on Incentives to Innovate and Encouraging Experimentation and Tech Adoption, Darrell West.

MR. WEST: Okay. Our next panel is going to address the topic of encouraging innovation and technology adoption and we have several distinguished speakers. Ed Fish is CEO of ePals.com, which runs a K-12 learning network devoted to safe, collaborative, and connected classrooms. His background is in building community-based internet products and innovation online.

Peter Levin is running a little bit late so he'll be joining us en route. He's the chief technology officer of the U.S. Department of Veterans Affairs.

Paul Peterson is a professor of government at Harvard and director of its program on education policy and governance. He also is the author of the book, *Saving Schools: From Horace Mann to Virtual Learning*.

And Marilyn Reznick is executive director of education leadership at the AT&T Foundation, and in that position she coordinates a range of innovations in the education area.

So I want to start with Ed. Let's talk about the K-12 market where I know you work. Research reinforces how important the right foundation is for future success. Are there any special issues or opportunities that could be addressed with incentives for technology adoption?

MR. FISHER: so K-12 I think is a very different kind of marketplace. There's an increased need to be safe and secure. There is much more teacher-mediated interaction and a focus on core skills, and to some degree that makes it different than other marketplaces. But at the same time K-12 may be the place that could benefit the most from the application of technology and I think that's what the opportunity is if we can innovate in the proper way.

So I'd like to thank Darrell for having me here today. And my distinct pleasure is to run a company called ePals. And what ePals is about, we're a K-12 education technology company that is building a safe and secure platform for building educational communities, quality content, and collaboration-oriented project-based learning. And when I heard a lot of the discussion today it really brought me back to many of the core elements that ePals has been about for more than 10 years. We're used by more than 650,000 classrooms around the globe, so when the President talked about connecting Kansas to Cairo, that happens every day on ePals, and reach millions of educators, students, and parents.

So we've heard also a lot I think about perceived obstacles to technology adoption in K-12. And schools don't have money for new technology. Current infrastructure we couldn't support them anyway. How do I keep students safe online? And what about bullying and other kinds of social issues? And won't new technology just be harder for teachers who are already stretched way too thin?

And I think it's time, and I think this kind of conference and what we're seeing the marketplace shatters those. So these assumptions are all wrong. Technology exists today that allows you to host collaboration and communication in the cloud and save millions of dollars for school districts on an annual basis. Technology exists today that allows you to apply rules and digital policy management. In my previous company we coined the term digital rights management and the first company in the space and so know a little bit about it, but applying rules and digital policy management to keep our students safe. And technology exists that allows teachers to automate interactions so that they can engage students in a much more efficient and compelling way. That takes into account how the student already finds them. The only time when most kids aren't connected is when they're in school. And that's a serious issue that we all really need to

address.

So part of it's about changing our mindset. It's not about adopting more technology; it's about how we leverage technology in new models that better engage the entire constituency of the education community. Educators, students, and let's not forget their parents because we know the one element that works across all socioeconomic strata is the more involved a parent is in their child's education, the better that child is going to do. So engaging parents in ways that understand that a lot of parents are working two jobs or they're single parents and finding efficient ways for them to be able to take part in their child's education is something that we could all benefit from. And a lot of technology allows us to do that.

So when I was thinking about this today, I think there are some steps we could take. And some of it's about lessons that we've learned from every other marketplace and industry that's gone electronic. We just need to apply those. We know that the Internet has already transformed music. It's transformed the entertainment industry. It's transformed the way in which we do commerce online. It's transforming government and we need to apply those same lessons into the education space. So to me some of the big things are connectivity and speed help full stop. Removing barriers help. Barriers to interoperability of data so that we can see what works and how to apply it. Barriers to comparison and validation of information and barriers to adoption. So it was neat to walk up to the Brookings today and I remembered back. Now, this both, A, shows my age and kind of a past career but when I think of the common core standards, what I think about is how the business community embraced the uniform commercial code in the 1950s. It helped markets grow. And so when I think about the next generation beyond common core standards I think about what is it that helps the school district in Beloit, Wisconsin, or the school district in Kansas City, Missouri, easily adapt to

what needs to be a nationwide marketplace. And that helps individual businesses as well.

So to make -- and I think there are sometimes small things because sometimes if we get too caught up in the large things it's hard to make the progress that really works. So to me there's two ideas here. One is standardized Internet usage policies. And I know it sounds silly but all around this country schools and school districts reinvent the wheel everyday to explain to parents here's what our set of policies are for using the Internet. And a very simple thing would be to make three, four, five templates, just like we did in the uniform commercial code to say we don't want to limit your choices but we want to make it easier for you to actually adopt something that stands as a real barrier. The other is shining a light on what works and why it works.

So I think from my background there is no tech crunch in the education space and that's a problem. If I want to very simply understand what is it that works in social computing and entertainment industries and the Internet I go to tech crunch and it shows up on the first page of Google. Because, remember, it's very important that when I put in the term that I actually be able to find it efficiently. And so there is no tech crunch and I think that's a really serious issue.

So from my vantage point, because when I hear a lot of the discussion today one of the things I was thinking about is, okay, so if we're supposed to be talking about how to incentivize innovation then I need to find common threads. Until I find common threads, then all the various good ideas that we hear have a harder time getting to market, have a harder time influencing people. So I've got two very simple ideas and there's a lot of folks smarter in the room than me. As the father of five kids I learn every day what are my limitations, so I certainly want -- I don't think that, you know, these came down from on high by any stretch of the imagination.



But first idea: Extend cloud first principles to education. It would certainly have a far greater impact than the impact we're already seeing in the federal government. And it would address cost issues that are very, very real for schools all over the country. So cloud first principles for education.

Second is if we're serious about online collaboration, writing for a purpose to audiences that are authentic, digital literacy, global understanding, then a very simple step we could do is set a goal of every student having an online collaborative account by 2015 because we're Americans. We need to -- we need to have a goal and we need to know when it's achieved. Man on the moon. And so some very simple goals can actually galvanize action on top of which we can build the whole set of value-added solutions and individual and adaptive scenarios that are really crucial to the future but we've got to take those first steps. And without a concrete goal it's very hard to know when that's been attained. So those are at least two ideas for consideration.

MR. WEST: Thank you, Ed.

Paul, you've written about virtual learning. How do you think we can increase innovation and adoption in the education area?

MR. LEVIN: Well, let me begin with a thought that the United States is a big market, and big markets encourage innovation and the United States over the last century has brought more innovation to market than probably any other country in the world. It may be that there's a bigger market coming online right now in the 21st century and we'll no longer be able to claim we've got the biggest market out there, but at least up until now the United States has been the biggest market. And when you look at what's been happening in the health industry that helps to explain why so much innovation in health care and pharmaceuticals -- so much innovation is here in the United States. It's a great big market.

Schools are tiny markets historically. Neighborhood schools, it's for the kids in the neighborhood. It's for 100 kids or 400 kids, small markets. It's very difficult to innovate in small markets. Now we are asking our educational system to undertake innovation in lots of tiny little markets. And the challenge that we face in moving to scale, and I've heard a variety of people talk about the need for scale and I couldn't agree more, we have to find a way of moving from multiple small markets to regional markets or a national market, ideally a national market. And so the idea behind the common core standards is maybe moving only modestly in that direction. So how can we get there?

Well, for one thing, a large market is going to attract very big investments and you cannot produce dramatically transforming educational experiences online without large upfront investments. Up until now most of the online learning advances have been marginal, incremental, with limited resources and that's probably where it should be in the first stages of the investment. But until we bring in those with deep pockets -- think of the deep pockets that are in the health care industry and the great investments they make before they bring products to market today -- when you have that kind of investment being made in education, you will have a transformative, online environment. And we're beginning to see that now. Kaplan was one example we heard about. Another example is Wireless Generation being taken over by News Corporation. A third example is Pearson Publishing forming an alliance with Florida Virtual School.

The one I like the best is still a small market but the potential is so great, and that's Middlebury College has teamed up with K-12 to produce language courses. Middlebury College is known for its language courses and they're now this coming month going to be bringing to market language courses in the K-12 sector that will be providing language experiences for people in those parts of the country that can no longer get it in their elementary and secondary schools.

Now, the reason I like that example is because one of the most powerful transformative events that could happen in secondary education is for universities teaming up with those who have deep pockets to create very exciting courses that are preparatory to a college experience. In terms of getting college ready that's where we could see a dynamic transformation, but to do that we have to have regional or national policy frameworks. And we have to create an environment where you can put a course out online and it's going to be an accredited course. And it's going to have to show that it is an effective course. It's going to produce the outcomes that are desired and that once it's been vetted it will be available for anybody to put on their high school transcript.

And the revenue from that course will go to whoever creates that course and is delivering that course. And the revenue can be shared between a local school and the provider that's created this course. It doesn't have to all go -- in Florida right now we have this model with Florida Virtual creating courses that are being taken all over the state of Florida and applied to the student's transcript in Florida, but all the money goes to Florida Virtual right now. So either you pay Florida Virtual or the local school district. Well, there's no need for that. You could have a blended formula. But once you get a regional national framework and you get a compensation system that rewards whoever creates that product based on the utilization of that product, and if you have a competitive system where the student is making the choices, the way to get the industry to be constantly improving is to put the student in charge of which course they want to take. So you have competition, you have accreditation, you have accountability, you have transparency. That is the way you can create a policy environment in order to have a transformative experience in the online world that will go far beyond the marginal increments that we have seen up to this point in time.

MR. WEST: Thank you, Paul.

Marilyn, what are private companies doing to encourage innovation?

MS. REZNICK: Thank you. For the private sector, education is probably one of the most important investments we can make. We need a highly educated workforce to be successful in an increasingly competitive and global marketplace. But to help develop the talent to help us create economic value we must not only invest but we must help drive innovation in education. Technology and the competition it has enabled demands innovation in the business world. To stay on top, to be the best, we have to see innovation in every aspect of our business. Innovation has to be embedded in our culture and we have to help bring that same condition into education.

So here are five ways that business can help do that. First, leadership. The business community has a responsibility to define the talents and skills we need and then collaborate with educators to create the kind of experiences that will enable students to acquire those skills. We need to better convey what the work environment is like today and it's very different than it was five, even three years ago.

Today, the workforce is mobile. We have all kinds of little smart devices that enable us to work almost anywhere, anytime. Educators should have the same options. Students are already very adept at using mobile technology for social networking, for casual communication. Now we need to apply that ability to some serious learning.

The second way is investment. Businesses can push innovation by targeted investments in research, in programs, in building models. We can help drive the innovation by partnering with our finances to make that happen.

A third way, technical assistance. We can share our technical expertise with educators and students to facilitate the creation of new models, new applications, new learning environments.

A fourth way is convening. We can help bring together other business leaders, educators, policymakers, to identify issues, map out solutions, share best practices.

And fifth, it's through advocacy. Business leaders can be strong advocates for innovation in education by talking on panels like this, by talking with other policymakers, educators, and other business leaders to again reinforce our vital vested interest in education.

And those are just some ways. But in all ways we need to be partners with educators. We need to respect each other's expertise and the business community needs to listen to educators so that we can better understand their issues, their needs, and how we can then partner to create solutions, and in that way we can help bring real innovation to education.

Thanks.

MR. WEST: Thank you very much.

I have a couple of questions I'll throw out to our panel and then we'll open the floor to questions and comments from the audience.

The first question concerns measures of success and the role of evaluation in education technology and education innovation. What do you think is the role of evaluation? How do we know what works and what doesn't work?

And the second question is on our earlier panels there were predictions of success in the education and technology area five years from now versus 50 years from now. That was kind of the range of optimism and pessimism. And so I'm just curious what each of you think. How long will it take before we actually will see the fruits of some of the ideas we've been talking about this morning?

MR. PETERSON: Well, if I can take a crack at that question, Darrell.

On the distance it's going to take us or how long we're going to have to travel on this journey to get there will depend a lot on the policy framework we put together. If we put together the right policy framework I would say 10 years. I wouldn't say 5, but I would say 10 years. If we don't put together the right policy framework it's going to take a much longer period of time.

The -- in terms of accountability, I see the word evaluation -- the way I would translate it as the word accountability. It's the biggest challenge out there. We, first of all, have to make sure that online learning we know who's taking the course and we know who's performing and we know that the work is being done up to the level of expectation that society has for that experience. And that's something that doesn't necessarily happen in classrooms today. We don't always know who's taking -- who's handing in the paper -- who wrote the paper that's being handed in. And we don't always know what the teacher is teaching in the classroom. In fact, it's very hard to know what the teacher -- so actually when you go to online learning there's an enormous opportunity for transparency. At the Florida Virtual School they're able -- managers are able to see what the teachers are doing and their relationship to the students. And, of course, they can see the curriculum that's being provided. So the transparency of online learning is absolutely extremely important for evaluative purposes.

Now, the other obvious thing is that the introduction of randomized field trials can be greatly facilitated by the onlining environment and the Kaplan comment earlier was very much on target in this regard. But I would think that we have to have also -- we've got to make sure the vendors are being held accountable. I mean, if we do -- if we allow anybody to go out there and say I've got a course, it's online, I want to get paid now, well, this is not going to work. We've got to have a system that allows for the evaluation and accreditation of courses without stultifying innovation. And that's a

balance that is going to be -- it's going to be an experiential solution, one that one can articulate theoretically in advance.

MR. WEST: Marilyn?

MS. REZNICK: I think there's a growing sense of urgency in the business community. Yes, we need all the right policy frameworks and this is really hard to do but we can't wait. I mean, our workforce depends on those students having those kinds of skills and abilities. So I think the business community is going to be driving for a little more acceleration here in making this happen.

And the other thing is I think students are going to demand this. It's their way of life. So they're either not going to participate because they can't and use mobile technology, or they're going to cry out for that to be part of their education. And I think that demand may soon push us to that tipping point.

I remember years ago when we were trying to introduce computers in classrooms there was a lot of fear, a lot of resistance, oh, my god, students will do nothing but play video games all day. Now we think it's terrible if there's not a computer in the classroom. So we've got past some of the fears, some of the resistance. Still a lot of work to do but I think we can do the same with mobile technology and overcome some of those obstacles that are still out there because I don't think a lot of us can wait.

MR. FISH: I agree with what the other panelists have said and I bring -- which is one of the things I think is great about this conference, I bring a slightly different perspective. And to think about the accountability issue I think of my board meetings every quarter and I think particularly of what Mitch Kapor says to me every quarter. And those of you who don't know Mitch, Mitch is behind Mozilla and he is chairman of Second Life. And Mitch was a founder of Lotus in the very early days.

But what Mitch says is nothing drives accountability like publishing the

data. And I've seen that work in the software space. There was an old theory that you never talked about your bugs. And now, of course, we know the community helps you not only identify the bugs in your software but fix them. And by actually putting light on the issue and not being afraid of what data says is I think the greatest thing we can do transformationally around accountability.

As to timeframe, to me the question is what are the intelligent ways we can apply a catalyst? Catalysts speed up reaction times. And so what I look for are what are the catalysts that make this evolution a 5- or 10-year effort, not a 50-year effort. And to me that's why cloud first helps. If we work really hard to be 10 years behind we haven't moved forward. And I look at, for example, the way in which wireless communications have completely changed many areas of the world. And until we say there are some things we can do to encourage the next evolution in a technology-neutral, solution-neutral manner, I think we're going to deal with small markets. And to me, cloud first is a great example of that and education is a perfect use case. I mean, talk about a compliance-oriented large collaboration-enhanced environment. Exactly the principles that we're talking about in the context of Cloud First. So those are my two thoughts on that.

MR. WEST: Okay. Why don't we move to questions from the audience? Right here. Do we have microphones? We have a microphone coming up. And by the way, has Peter Levin arrived yet? Okay, apparently not.

MR. SAXBERG: Bror Saxberg with Kaplan.

Arthur Denning, I think his name was, years and years ago, tried to convince the automobile industry of the importance of statistical controls on variability of machine parts -- this was in the early '60s -- was unable to do so after a long time of convincing and so he went overseas and basically the Japanese really loved his ideas,



transformed their industry, and then years later those cars caused our industry -- our car industry to transform as well.

Do you think that we have to wait for other countries to do this first and then that will drag us kicking and screaming forward? Or do you think that we can do it ourselves?

MR. PETERSON: Well, I have been saying in speeches that if we don't do it it's going to happen anyhow. So let's not sit around saying this isn't going to happen because it is. And you have to look to Asia. I don't think Europe is going to move that quickly. So I really think it's going to happen in Asia and we're going to have to -- we have a great advantage. I mean, we have so much high-tech concentration and so much broadband capacity now so that right now we have the advantage. But it's not going to be around for very long.

MR. FISH: So I'm reminded of an adage, which is cannibalize yourself before someone else starts cannibalizing you. And I think that time is really past. I think we are being and that's a fact. But I think it goes back to Paul's comments which is small market, large market is unbelievably important. And I think about the changes that have occurred in the availability of capital. So it wasn't that long ago where there were mid-market banks. There was a mid-market economy for people who needed the next stage of material investment. That marketplace is gone. That marketplace now exists in Canada for mid-market IPOs. And when we think about the infusion of capital that will actually be necessary to drive scale, I think we need to think about issues like that.

I know those are much broader than our ability to solve them through policy clearly, but there are things we can do. And I think Paul had some very good ideas around how we think much more about a national market because I think that goes to your point, Bror, which is the situation we have here is not the way it is overseas. Top-

down decision-making, hierarchically done, ministries of education. It doesn't mean it's always right, but it does mean that I don't have the small market issue.

MR. WEST: Other questions? Yes, in the back.

SPEAKER: One thing that's been clear throughout most of the day is that the kind of innovation we're talking about really depends on the network not becoming a constraint. And in terms of wired broadband I don't think we have great fears on that score. However, in wireless there actually are great fears that the demand curve is going to hit the supply curve. And there are really two ways to deal with that and one is national policy that somehow opens up more of that and that's an investment question. The other is to start allowing a set of restrictions that an event to pick up on. I guess Ed said on the word if they start permitting a network that is not neutral. And I'm curious about this whole question about how one promotes the investment in that infrastructure in such a way that money doesn't chase away innovation.

MR. FISH: All right, Paul. Now it's time to use your Harvard degree.

MR. PETERSON: That's too hard a question for me to answer.

(Laughter)

MR. FISH: I guess I'm reminded of what one of the earlier panelists, which is -- I think it was the gender stereotype around men and their answers so I kind of feel like that man who threatened. Right? So I guess that means I'll hazard a suggestion.

It strikes me that the issues that we have around network are clearly not limited to the education sphere, are clearly much broader. But I think there are purposes that are public in nature that whether it's programs through the Federal Communications Commission, National Broadband Initiatives and other kinds where we say there's a public purpose that's meaningful, we can start to make inroads. So I don't pretend to be

an expert in telecommunications policies as they relate to network utilization, but I do think that education is a wonderful public purpose to be thinking about these issues in that context. I think of, for example, you know, there was a lot of debate not long ago frankly, in and around whether web hosting was a proper purpose for the use of E-Right Fund. And I think in some very recent guidance out of the Commission they said something which made a lot of sense. Does it really matter if my message is in the form of HTML in an e-mail, HTML in a blog, or HTML in a Wiki? The answer to that has to be no. And let's please let the marketplaces decide and the users decide what's the most efficient way to communicate.

MS. REZNICK: Well, I'm sort of the elephant in the room here sitting on a network company.

Those are complicated issues. And as I'm sure you know there's been a lot of debate about how the network should be managed. We adhere to the principles that the FCC has put forward. We know there's going to be another huge hearing coming up -- Is that this week? Next week? -- on that. But we continue to support the principles that the FCC has put forward to date. We appreciate the fact that the network does need to have some management. The network doesn't just run by itself. Someone does have to oversee that and manage that, and we want to do that in ways that are appropriate and that obviously continue to support education as we've all said. So from the network company that's my answer.

MR. WEST: Other questions? Right there.

MS. MULLINS: Thank you. I'm Chris Mullins. I'm with the Instructional Technology Council. We represent community colleagues around the country that have distance learning and online courses. And I've heard a lot of comment about we have 5 to 10 years, 30 years, whatever it is, to do all of this. And I don't think that's true. I see it

happening right now.

We just did a survey of our members and we represent probably the most advanced of the colleagues in terms of online learning and they have experienced a 22 percent increase in student enrollment in distance learning which is huge compared to the face-to-face enrollment which has been fairly flat. It's documented by 1.5 percent from the Sloan Foundation. So I'd really love to see an emphasis -- I know the person from Kaplan University, they're a for-profit company. I'd really like to see that emphasis on faculty training which the community colleges especially are swamped. They have all this student enrollment. Their state funding has been cut so they don't have money to put into the faculty training, although the top schools know how important it is so they're trying to figure out how to do it. They're also faced with cutting faculty, so I'd love to see more.

And I would have liked to -- I asked this of the FETAL folks to see an increase in programs like the Learning Anywhere partnerships from 10 years ago, the focus on faculty training, the preparing -- was it PP3? It was preparing faculty to teach online. I'd love to see more emphasis on that rather than just the assessment because right now we kind of know a lot of what works. We just need to do it. And like AT&T, the workforce demands these technology-educated folks in math and science, all those, and we can do it but the colleagues are really strapped and need that funding.

So I don't know if I had a question so much as sort of a comment for you to respond and I'll get off my soapbox as far as --

MR. PETERSON: Well, at the college level you're certainly right. The 22 percent growth rate has been happening annually over the last 5, 6 years, and I think the reason why that's happening is because colleges are in a very competitive market. It's also the case that community colleges and junior colleges have a very flexible

workforce and they now will hire you only if you can teach a course online. They have a lot of part-time workers and they can be ruthless in saying, well, you don't have enough students in your class; I'm sorry, you can't teach this year.

And so the people are acquiring the skill set in order to teach online if they want to keep their positions or a few tenured positions but not many.

So I'm not sure you need a lot of training programs. What you need to do is to have a very flexible teaching force if you want to change your human capital rapidly. Because you've got to bring in new people to do this. It's not going to be just getting people like me to do that. It's not going to work. You're going to get people a different set of skills to be able to be effective in the online environment.

So yes, it's going to happen very fast at the college level where there's a lot of competition out there. It's at the elementary and secondary level where there are a lot of virginites, a lot of barriers, and a lot of vested interests where you're going to have to have striking policy innovations at the state and national level in order to get the changes at the kind of rate you're talking about.

MR. WEST: Okay. We have a question over here.

MR. ROWE: Dick Rowe, Open Learning Exchange.

As a member of the Open Coursework Consortium started at MIT, interesting, about 85 percent of MIT courses now have an online component that's open. Nothing is free, somebody is paying for it, but at least the students don't pay.

One of the interesting dynamics of this in relationship to faculty training is that MIT has found that the quality of instruction of those who are going online has significantly increased because, again, the transparency. A lot of people are looking at what's going on in that classroom and so they're seeing side effect that the in-class quality of instruction has improved as a result of the external availability of that

information.

MR. FISH: I think you make a really good point and kind of my thought process on that is so what does MIT have? A really great network and transparent data. And I think that shows you the transformational capabilities of when those two things come together.

MR. PETERSON: Yeah, MIT started this about, what, seven years ago. There are now 350 universities that are part of that open course consortium opening open course -- free open course (inaudible) around the world. The United States is probably one of the least represented in that consortium from Asia and Europe.

MR. WEST: Okay. There's a question over here.

SPEAKER: Hi, I'm Chris Losey with the Council of Chief State School Officers. And thank you for acknowledging the market-making capacity of the common core. We think of it as powerful but totally insignificant to the kinds of challenges that we're facing in terms of -- especially opening a market that's going to incent innovation around some of the technological pieces that need to be solved. And as we start to think about the sort of enabling frameworks that would allow for market creation in the technology space -- data standards as mentioned earlier, interoperability standards -- that calls for a sort of regulatory framework that's probably much more kinetically managed than government can think about right now. What are your recommendations for governments as they start to think about all these other policy innovations that are necessary from the human capital perspective from others around standards management.

MR. PETERSON: I agree with you. It's very difficult to get governments to figure out how to do this and it can be very controversial when governments take on setting standards as the common core standards history especially tells us. Accrediting

agencies have historically been private entities, not public entities. What I worry about private accrediting agencies that are controlled by the industry is that the standards get set very low. So it's not an easy solution. I think it's well worth a lot of deliberation as to what's the right mix of public and private engagement to establish a set of standards that are on the one hand ensure high quality. If we take the charter school experience as an example, the charter schools in some parts of the country are excellent because they've had high standards set by the governments. Other places they had very low standards, if any, and a lot of low quality schools were set up. So you have to worry about this. And the sooner we worry about it and get it into place the better off we are.

But charter schools are small markets and this is a big market. If it's going to be successful it's got to be a large market, so it really calls for thinking together by state policymakers so if they can come up with a joint policy, if it's impossible for the federal government to get involved.

MR. FISH: I think it was in the last panel where someone was talking about -- one of the questions came up about the relationship between private foundations and government programs. And I think this is a particularly ripe area because things that we've done on the technology side to drive certain kinds of standards like PCI. All kinds of standards come in the end from the direction and leadership of a consortium of companies and groups in combination with enabling kinds of legislative schemes. But in education I think being driven out of foundations is actually extremely important as it relates to the public good. And I think based on that additional work that can be done as seeded from foundations, then you get enough of a lift where then companies can really start to work in a very, very active way. So I think that this is a perfect area for that kind of work actually.

MR. WEST: We have time just for one last question (inaudible).

MR. GREIFF: Thanks. I'm Rusty Greiff with a company called Grockit. We build social media platforms and adaptive learning platforms inside school and outside of school.

I'm interested in Ed providing some specific context. Ed's a friend so this is not a softball homerun question I'm throwing but it's actually relevant to some of the conversations we've been having all day. Interesting in providing some perspective for folks in the room on some of the healthy tensions that you deal with as a private company and as a for-profit company as related to the demands as you mention from a board perspective, ROI, very real things, to the reality that we talked about related to the cyclicity of adoption penetration because I think that we've talked a lot today about the power of the private sector being truly disruptive and innovative. I've had a lot of conversations with colleagues of mine outside the room of some of the struggles that we're facing as we're trying to really penetrate in the K-12 or higher ed space because the marketplace and the demand we think is there and that they want but it's just the challenge of actual true adoption because of some of the other very real obstacles that existed for decades if not for even long.

So I just would love to get that perspective because I think your point about the foundations being part of the solution I think is really powerful because it may provide new capital and new energy to really make that penetration work.

MR. FISH: Well, thank you, Rusty.

One of the things where I think ePals has been lucky is if you understand that this is a longer term kind of solution -- that there aren't panaceas and there aren't quick fixes because transformation never comes through those -- what I think often happens with very real world issues around return on investment in what period of time from venture capital felt is that you tend to not engineer or architecture for transformation



and that merely reinforces the problem. Now, except for those days -- couple days after when I'm kind of whining about my particular board after a board meeting, one of the things that we have been very luck with is a group of folks that got committed around a private company solution that could drive transformational change in education. And so ePals was kind of founded out of folks who had built AOL and the Mitch Kapors of the world. And what that meant to us was a double bottom line, that is a purpose to do good. But to apply capital that could only come in the context of a privately funded company.

My particular advantage or at least pleasure here has been it took patient money because you knew it wasn't going to happen in one year, in 18 months, or in 36 months, but what it took was a commitment to say we know that this market when it moves will and we need to be ready for that and think about how we can be double bottom lined. Ted Leonsis now says he won't invest in any company that's not double bottom lined. And because it really is possible to do well and do good and I think education is a perfect use of that. But if we had not had patient money, it wouldn't be here.

MS. REZNICK: I just want to put a plug in for a different kind of model for bringing venture capitalists, venture philanthropists to the educators' table. And this is something that the U.S. Department of Education and the Aspen Institute are doing mid-January on something called the Innovation Summit where the projects that were applicants in the investing and innovation fund, the grants' program, couldn't all be funded. But there's going to be a forum for them to come together and then have venture capitalists, philanthropists, come, talk to them. It will be like an expo hall where they can actually go, visit with them, and find out on the spot if there are projects and organizations that could be worthy of their funding. So it's just a different model that we've not seen before, but a very creative way of thinking about bringing those two

worlds together.

MR. WEST: There you go. If any of you have ideas, that's the place to go.

We're out of time on this panel but I want to thank Ed, Paul, and Marilyn for sharing their insights. So please join me in thanking them. (Applause)

Our keynote for today is Governor Bob Wise. And Bob, as many of you know, served as governor of West Virginia from 2001 to 2005. During that time he set up and funded the Promise Scholarship program, he created a character education curriculum, and he provided teacher salary bonuses for those achieving national board certification. Prior to that time he served in the U.S. House of Representatives from 1983 to 2001. Now he's the president of the Alliance for Excellent Education. And this year the Alliance set up a digital learning council co-chaired by Governor Wise and former Florida Governor Jeb Bush. The Council seeks to identify policies that will integrate current and future technology innovations into public education. He also is the author of a book, *Raising the Grade: How High School Reform Can Save Our Youth and Our Nation*.

So please join me in welcoming Governor Wise to Brookings.  
(Applause)

MR. WISE: Thank you very much. And I'm going to pick up where Marilyn left off, which is that we can't wait. And that's what the Digital Learning Council is about. I'm going to bring you the perspective of, I think as much as anything, what policy and the urgency to work on it. I felt very privileged when I got a call a number of months ago from former Governor Bush, who was, of course, extremely active with the Florida Virtual Schools and a number of other initiatives in the state of Florida improving education, asking him to co-chair with him the Digital Learning Council.

The Digital Learning Council is a group of about 100. Many of you are in this room, which I appreciate the effort that you put into it, that met for several months. Met digitally. There was not one meeting that was in person. I think there were 70 individual digital meetings as well as every member was interviewed personally, digitally. I've never seen so many people meet so many times and not one lunch was bought for anybody.

But the Digital Learning Council worked for a number of months and came out with 10 essential elements. And you have these on a card, I believe. Ten essential elements for high quality learning that we hope provides a roadmap to state policymakers, local policymakers, and federal. Now, I do just have to say roadmap because an earlier question mentioned a manifesto that Wise and Bush had been involved with. Now, I have to admit I had a vestigial pang as one who ran for office a number of times during the Cold War, I spent my political life running from -- I never have been associated with any manifesto, and I'm pretty sure that anyone named Bush hasn't either.

So this is a roadmap for policymakers to look at as we move forward. And for many of you who are familiar with the data quality campaign which I consider to be an extremely successful effort to identify the policies that are essential to policymakers at the state level on implementing comprehensive data systems to drive decision-making in education. This is a lot like the data quality campaign. I like to call it the DQC, only on steroids because of what we were able to learn from the many lessons of the data quality campaign and to use their template.

Now, the Digital Learning Council comes at what I call the combination of the Ms -- the moment and the means. This is a time when every governor -- and remember there are 29 new state governors. This is a *Jeopardy* question, \$500 for

political trivia. The largest number of new governors since 1950, covering about 80-some percent of the population. And so at a very critical time, in less than a month for some of them, going to be presenting a state of the state message. Now, they've come into office and they knew the state budget situation was bad, but now they've met with the state civil servant in the budget office who actually does know what the numbers are and it's far worse. And so they have to present -- they have a choice. They can either just hunker down, do the same thing with less, and get even less outcomes in education. Or they can decide to strike out. That is strike out in a bold way. That's the choice they have in front of them. And they have to decide because it'll be the first session of the legislature that will be their high water mark. They have to decide whether they're going to be boldly innovative or quite frankly, over the next few years, badly irrelevant. And so that's the context at which the Digital Learning Council comes about.

So let's talk for a moment about what the moment is. The moment is this, and the Alliance for Excellent Education, my organization which was joined with, in this case with Governor Bush as the Foundation for Education and Excellence, but my organization, the Alliance, issued a report last year called *The Online Learning Imperative: The Three Looming Crises*. We saw three factors coming together. I'm going to quickly tick them off. State budgets. It's what I call, speaking of moments, the General Motors' moment. This is what GM faced about three years ago. We're not making a great product and now there's a lot less money to make it. And so demand for higher outcomes and yet less revenue to achieve them with.

And so that's essentially what almost every state is going to be facing. Stimulus package is now expired and while there will be some spending out, if you look at the budget projects, whether by the National Association of State Budget Officers, the Rockefeller Institute, Center for Budget Priorities, look at any of them and it's pretty bleak

for the next three years at least for state budgets. So you've got less money to work with.

Teacher demographics. We have -- the state of Georgia has 440 high schools and has 88 certified physics teachers. And that's representative of the country. So how do we get high quality content into each one of those high schools across the country? Whether they're urban intercity to extreme rural?

Second, if you look at the NCTAF report from last year, something like almost 50 percent of our teachers are 50 years or older. So even if every teacher -- if you believe in the model of every teacher being the sole repository of content in the classroom, the content teachers -- the experienced ones are going. And in fact, the NCTAF Report is informative because it also shows that in 1987-88, the typical teacher had almost 15 years experience. Flash forward to this year and the typical teacher has something like two to three years' experience. So now once again the critical time to marry high quality content with the classroom.

And then the third factor, the pipeline. And the analysis that I've done, and Governor Bush worked at this extensively during his terms as governor with the Florida Virtual Schools and what not, I was involved somewhat in West Virginia but quite frankly I had my wakeup moment about three years ago when I started looking at the numbers that I've been relaying plus this next one and realized that we can't get there from here. The Obama Administration, Gates Foundation, Lumina Foundation all have set very -- have set the goal for where we need to be in postsecondary achievement and they are absolutely correct. And if you look at Tony Carnevali's work and you can see it just underscores it.

There's a problem. We can't get there from here with the same delivery model. If we keep churning out the same amount of kids who either drop out or if they do get a diploma, high school diploma, then go on to need remediation, we can't get there

from here. So that's the moment -- the budget situations, the demographics of our educators, and the pipeline.

Now, so let's talk about the means. So Bob, why is this man smiling besides the fact that I'm inherently optimistic? Well, first of all, this is taking place around us anyhow. The question is whether we put any order and accelerate it. It's happening when Clayton Christiansen and Michael Horn write that 50 percent of all high school classes will be online in a decade, more recently a superintendent in Houston announced that 30 percent of classes would be online for high school within 5 years in his district. So this is going to happen. The question is whether as many children as possible have access to it. And so the means become critically important.

With the DLC, I think several things have happened. The DLC raises some critical issues. First of all, and the very first principle, all children -- all children should have access wherever they are: public school, private school, charter school, whatever. I've never been a voucher supporter. Put that out there. Yet I don't see this as a voucher -- that was a debate that was taking place about another era. The digital -- with technology you leapfrog that discussion. And now what we have, as was explained earlier by others, you have the means to bring at a low unit cost high quality content. So all children having access.

Competency-based learning. I know that we all love the seat time, a requirement. It doesn't make any sense, of course, in today's era. And so a child that needs more time ought to have more time. A child that can advance faster needs to advance faster. And actually, I would argue over time that becomes cost effective because now we're moving the child that would have been sitting in a seat for 12 years may sit there for 11 or be able to take more advanced courses and save time on the higher ed side.

Instruction needs to be individualized, which in these principles that's written throughout this. And of course, technology provides the means for that. And funding needs to be on different bases than it currently is. It needs to be -- you can take a look at their different funding models. Florida Virtual School, for instance, which is performance based. The district pays on if that child completes that course satisfactorily, not because that child occupied a seat. And so that actually changes the dynamic by which we're compensating and forming budgets. So that's one set of the means that are there.

Second, it's been referenced several times, common core standards. I can't overstate the importance of that I think coming by coincidence at this time. State-led movement, not federal. Forty-four states have now adopted. But in English language, arts, and math it sets the standard. So now our publishers know. Now all our content generators know. Now -- but what we also have, the Herculean task of doing and every governor is going to face as well, is it's one thing to adopt the standards. It's something else to implement them because you start with assessments and the action that the U.S. Department has taken to assist states in developing with the two consortia of developing those assessments. But there's a whole other set of assessments that will need to be developed. Then you don't stop with assessments because now you've got to move to teacher preparation, recruitment, and development -- professional development. What is it that as we're asking our teachers to step up the game even more.

And then the third one, of course, is curriculum development. And so what will be, as the states have worked together, will they come together to work around common curricula as well?

And then the third one, and I can't pass up this opportunity. Actually, it was not in my original remarks but anytime I hear questions from two very senior and

influential representatives in Congress -- I heard one from Senator Rockefeller's staff person and one from Congressman Waxman -- what could be an ESCA? I've got to answer that.

The first is increased research dollars to assist -- to assist, make sure no state -- almost no state can afford it. The state of West Virginia, we were supposed to be doing significant research given all the other problems that we had? No. The only one who can adequately fund that is going to be at the federal level.

Second is flexibility and Title I and other programs. Technology does not lend itself well to parameters. I mean, it's like trying to keep a thoroughbred racehorse locked up in the stall the whole time or in a very controlled paddock. You can't do it. And so -- and then another initiative would be -- and this one I may differ from the department a little bit, but it's looking at how technology -- but I don't think so -- how technology can be successfully used as a model for transforming the lowest performing schools. How does it get applied?

Are we all right on that, Jim? Thank goodness. I don't want to be on the other side of the rock star. I'm singing -- I'm in the band.

So how can that -- and then so but this also then brings us onto some questions that need to be asked. And I don't want anyone writing down or even taking away the idea, okay, let's wait until these questions are answered. These questions actually -- I think most of you in this room have some of the answers already. We just need them compiled for the policymakers.

So here are some of the key questions. One is we need to make sure -- and that goes along with these principles -- is everybody needs to be doing a scan of his or her local policies, state policies, and federal policies to see, number one, what it is that is a disincentive to the effective application of technology in our schools now.



Second, so what is it that's holding it back? The model that somebody used earlier about California. You can have online learning; it just can't come from more than one contiguous county away. Now, I like that one. That's my -- I think you have to apply the Amazon test in this case. Does it make any -- you and I go home. We order -- how many people put off a trip to the mall this year? Why? Because I'm ordering online. So with Amazon, would you tell me that I can order a book online actually for my Kindle but I have to go stand in a physical brick and mortar store to download it. I have to go stand in my local store to download it. That to me is about the equivalent of that requirement.

And so what is it that's -- the requirement that a state -- that the teacher has to be certified within that state? No, we want high quality teachers, don't get us wrong, but there are other ways to make sure that that teacher has the content knowledge and the ability as opposed to requiring that that teacher be certified narrowly within that state.

Second, cost effectiveness. There are two levels of cost effectiveness. One is getting a greater outcome for the same expenditure of dollars. That one I think I can demonstrate pretty readily and indeed we have documentation on that already. The second one that's harder is the cost effectiveness to a hard pressed school district to say let's make the investment now at a time when we're seeing our budgets cut. There we need the private sector to come forward and help provide that cost effective information. Now, I can make some anecdotal arguments. If I've got three high schools in a district and each one has only five students that want mandarin or want the advanced calculus course, it makes no sense for me to hire a teacher -- and I can't afford to anyway -- to hire a teacher for each one of those schools. What I can do, via digital learning, is provide one teacher. And I can do it whether asynchronous or synchronous, and do it in

such a way that now those students have ready access to it. That to me is cost effectiveness. And so there are a number of other illustrations as well, but how -- but particularly, how do we bring -- will this ultimately prove to bring cost down?

Third, proof points. Here we need all -- because remember these policymakers -- you're sitting -- you're one of the 100 new members of Congress. You're sitting -- you're the President getting ready to propose and then go to the Hill to fight for a new ESCA, you're the governor either just elected or still there, and the hundreds -- literally hundreds of new state legislators, they're all meeting and having to make critical decisions within the next year. Actually, within the next few months. And so that's why the urgency to providing proof points of what it is that's working. The largest successful example probably Florida Virtual Schools provides excellent case studies. But others as well.

And then one that I have a special desire for is I think there's a real need to be able to demonstrate exactly how digital learning is working to improve outcomes for the most disadvantaged students and show me the proof points that I can then profile across the country because once again, if you're talking about in the Clayton Christensen-Michael Horn approach, the non-consumer -- the non-consumer, and it's already being used, credit recovery, dropout -- recovering dropouts, remedial work, and increasingly it's going to be used, I believe, in the lowest performing schools.

We need extensive discussion about the role of teachers. That's been talked about here. We have to first recognize that 75 percent of this is going to be in blended or hybrid situations. So the teacher is still an important -- a critically important element in education. Arguably -- well, is. Not arguably, the most important element, but the teacher's role is going to be changing. I see this as enabling a teacher. The military talks about a force multiplier. Boy, what a luxury if I were a teacher not to have to be the

sage on the stage every day but to be able to use my pedagogical skills and so that I could interact with students and meet their individual learning needs because now I've got the assistance of some of the highest quality content in the world coming in through a variety of means. And yet we have to make sure that that is understood.

And finally, the technology and explaining how technology is not some sort of snap on tool. It's not just something -- another new gadget to put on the table. It's a total learning environment. And it's not just layered on. You do have to change the total learning environment. It doesn't mean you're doing away necessarily with the brick and mortar school but that school now becomes a learning center, or the library as somebody else said or something else. And indeed, students may be taking courses a variety of ways. Two of the courses may be blended or hybrid. Some may be traditional. But you have to embrace a total change in technology.

So that's why the Digital Learning Council was created. That's what Governor Bush had in mind when he put out the call. That's what all those who contributed wanted. And so now we have the 10 principles. So the Digital Learning Council now moves to the Digital Learning Now. And there is a website, digital learning now -- this is surprising -- [digitallearningnow.com](http://digitallearningnow.com). But also it's important to work as the digital learning now works, it's also important to work through each of your means to advance technology.

Once again, critical decisions. Wherever you come from -- nonprofit, for-profit, academic -- I don't know a time when I've seen more crises and more opportunity than I do right now in education. We -- this cannot remain and will not remain a static system. And so that's why it's the moment and the means are both here.

And I do just want to close out with one final observation. I don't want to hear anybody anymore talking about technology and the classroom of the future. We've

got to be talking about the classroom of the present because that's the generation that's sitting there right now and that's the one we're going to be depending upon for our immediate future.

So thank you very, very much for your interest. I'm happy to answer questions about the Digital Learning Council and also why we need to move digital learning now. (Applause)

MR. WEST: Okay. I have a question and then we have time for a couple questions from the audience as well.

This morning we've heard lots of good ideas about how to move forward in this area but I'd like to ask you the implementation question because several speakers this morning have mentioned the fragmentation of the U.S. education system, the local school boards, the number of local school districts. How do we overcome the political fragmentation to actually implement some of these good ideas?

MR. WISE: Well, there is a bit of a challenge. It's what I call trying -- arching principles and standards, but basically you're giving them the flexibility. That's -- given our governance system, that's the only way I see happening.

But the other one is best practices. That's what I think is so important. The common core. That was not once again a federal initiative. Our organization was involved in that from literally the very beginning. That was not -- that was an initiative by the National Governors' Association, chief state school officers, ACHIEVE, the Hunt Institute, the Alliance, and then later Naspien and a number of others. But all -- it came from the states. Because the recognition -- they needed to have a common set of standards and they needed to be able to work together. They were forerunners to that, too. NECAP and New England and others achieved some of its work. But that's what I think will probably do it. So some early examples of success I believe will drive a lot of

others under the umbrella pretty quickly, or under the tent.

MR. WEST: Okay, thank you. Questions? Jim.

SPEAKER: Bob, there was an economist here earlier who had a pretty doom and gloom picture of our ability to make rapid progress on this. And I was wondering, given your political experience, how can we actually overcome the challenges laid out to make rapid progress on this front?

MR. WISE: Well, I mean, I think the factors laid out are all real except that I think that the -- I believe the confluence of events and the nature of the problems we face are going to drive change must faster than we think. And I also want to take a little more optimistic view than perhaps some of which I've heard expressed.

So let's talk about one of the elephants in the room. There are a bunch of them but one of them -- okay, what about unions? Teacher unions? Okay, I understand the reluctance and the resistance, but I also understand that every union in this country has had to make adjustments given the force of events. I grew up in the most heavily industrialized state in the nation and yet you don't find the traditional industrial contract with the machinists, the UMW -- United Mine Workers -- and a number of the others. The same thing is happening within the education unions right now.

Now, let me present something a little -- Jim, I don't think you and I have talked about it but let me present this. What about if an organization of educators -- whether it's teachers' unions, National Board of Professional Teaching Standards, TAP, you name it -- what if a group came forward and said, you know, we've got some of the highest quality content teachers in the country and we've got a fair number that don't want to stand on their feet for eight hours a day in a classroom anymore? Why don't we put together a group and go market that to online providers, whether we're coming to you as a school district superintendent and selling it directly or

we're going to K-12 or any of the other online providers and offering it up. And now it's an exchange between that business division as opposed to a collective bargaining contract. Collective bargaining is still in place for the district and those that are still teaching in the district but now this assemblage of teachers can be coming online from any part of the country.

So I think -- my sense is that there will be -- there's always that initial resistance that was talked about but I also believe that some folks particularly are going to be looking at this saying technology, you can't stand in front of this thing forever. What we need to be doing is figuring out how to benefit from it. So I happen to be optimistic on it.

From policymakers' standpoint, you know, I don't know where you -- look, I've been -- I was in government 24 years. I know what it's like to try and wiggle and squirm. Maybe next term we could deal with that. You can't duck this one anymore. I mean, the budget situation is so severe that you simply can't keep making the same decisions.

In the state of West Virginia I vetoed a budget one time -- the only budget, I think -- I vetoed a budget because they cut out the technology money. What was our final -- when you get down to the level of detail, the final compromise was that we extended the life of school buses for another year, which 12 to 13 years in a row on a school bus in a rural state is a lot. But when you get down to that level of detail what you recognize is you can't keep using the same model. And so what you have to do instead is change the model that you're working in. You have to make it more transformative. And as was pointed out earlier, the main way that every industry I've seen and it's documented as well, is increased productivity and cut costs is by effective application of technology. Folks can't duck this one anymore.

MR. WEST: Okay. We have time for one more question. Paul Peters.

MR. PETERS: So, Governor, your Digital Learning Council had a number of principles. I didn't see as much on accountability. How are you going to ensure high quality offerings in the digital space? Has your group thought about that? What do you say about that?

MR. WISE: There actually is. The main accountability item is how -- student accountability. How well do students do, which would be -- which is listed as one of the elements? But, no, the accountability, if it's not in there then we need to spell it out much more because that runs throughout. I happen to think that you actually are changing the discussion about accountability because if you're moving towards a much more performance-based system, now you've -- and you're moving away from a seat-based system to a competency-based system, that's all about raising the bar, not trying to slide under it.

MR. WEST: Okay, thank you, Governor Wise.

MR. WISE: Thank you.

MR. WEST: We really appreciate all of your leadership.

(Applause)

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