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Our objectives for the session today are threefold. To provide a brief introduction to systems thinking for educational leaders, to encourage you to think systemically about the work that you do, and to encourage you to become systems thinkers and system thinking leaders.

Before we begin let me say a word about the readings. I'm providing you with three short readings, relatively short readings. Those of you who are captured by this subject and I hope that will be all of you, will want to explore in more depth this important topic.

I will be providing you with some online resources at the end of our session this morning with the hope that you will spend some time looking at those and following the paths that you'll find in those to other very useful and very current material on systems thinking.

The first of the three readings that I provided to you is a selection from Peter Senge's book School That Learn. This is particularly important book in education in the last 10 years.

It came from an earlier book in which Peter Senge and others tried to identify the characteristics of effective and more effective organizations versus less effective organizations.

What they discovered was that the principles guiding that first books, which was called The Fifth Discipline, applied very much to education. And in fact large numbers of people who bought those early books were educators.

So in Schools That Learn they explore the principles from The Fifth Discipline and apply them to schools. What they found was very powerful.

There are five disciplines for a learning organization. Five disciplines that distinguish more effective organizations from less effective organizations.

These five are personal mastery, self focus and lifelong learning, mental models, disciplines that encourage self reflection and inquiry, shared vision, the need for and importance of mutual purpose in the organization, team learning, the ability to work effectively in groups, and the fifth discipline, systems thinking, the ability to understand complexities, linkages, interdependencies.

We're going to focus just briefly on two of these, mental models and systems thinking.

Mental models are an incredibly powerful but simple idea. Is the idea that we all carry around in our heads ideas and models about how to interact with the world and how to solve problems. How we face the various situations that come across our desk.

Mental models are deeply ingrained assumptions or generalizations, sometimes even pictures or images that influence how we understand the world, but more importantly how we create and take action.

Of course mental models can be a very useful, but they can also be a very limiting, constraining factor because new insights often fail to get put into practice because they conflict with deeply help internal images or models of how we see the world, images that limit us to the familiar ways of thinking and acting.

So to what are we referring to then when we talk about systems thinking? Systems thinking can be thought of in several different ways.

One, in the way we are looking at approaching it today as perspective on reality that focuses on sharpening our awareness of systems and how the parts of system work together, how they interact. How they affect one another.

System thinking can also refer to a way of understanding reality that emphasizes the relationships among a system's elements rather than the individual elements themselves. A key concept behind systems thinking is the idea that the whole is greater than the sum of its parts.

For others systems thinking connotes a set of tools such as casual loop diagrams or stock and flow diagrams and simulation models. Different tools that help us visualize, map and explore dynamic complexity.

For still others it's a vocabulary. A vocabulary used to express one's understanding of dynamic complexity. For example systems thinkers often describe the world in terms of reinforcing and balancing processes. Of limits and delays. Of patterns of behavior over time.

The readings that I provided to you and the website sources that you'll get at the end of the session will take you to places where you can explore more of these concepts in detail.

So let's pause for a moment and ask a question. What is a system, then? What am I talking about when I say a system, systems thinking? So what is a system?

Simplest definition of a system is a system is a set of interrelated elements that are organized to achieve a common purpose. That captures a lot.

The systems can be natural or they can be manmade. They can be simple or they can be very complex. Most of us these days are hearing a lot about systems when we think about climates and climate change and the ecosystems of the earth.

But systems also can be manmade organizational systems. Systems vary on a number of key characteristics. They can vary on the degree of openness of the system.

Some systems are small and closed and contain a very limited number of elements. Some are large and complex containing a large number of elements and a large number of interactions with other systems.

There can a number of different levels in a system or what we sometimes talk of is the hierarchy in the system. The different levels that interact with one another. Certainly education, the hierarchy of educational systems is a case in point.

Systems can vary by the degree of self regulation that they are capable of practicing or that govern how they function. And that being the idea of homeostatic balance and feedback.

The idea that organizations want to be in balance and that there are constantly systems of feedback helping the system to stay in balance. That can be both a positive and I'm sure you can a negative constraining factor particularly in organizational systems.

And the fourth characteristic would be the [purposiveness?] of a system. That is the number and complexity of the goals, no objectives that exist in the system. These can range from one or two goals to a large numbers of goals.

Now of course you can see that we're talking about education again. The complexity of the education goals and objectives that we have make the purposiveness of the system a rather complex one.

So now we switch to the question of why systems thinking is important for educators. And there are a number of reasons.

This is a particularly exciting time to be an educator but it's also a particularly challenging time. That's because of a number of factors.

The increasingly complex world that we live in, the increasingly complex educational landscape that's required in this world, the accelerating pace of change. Because many of shortcomings in education can be explained by a lack of alignments among key system components.

Alignments that are more and more with time out of alignment. It's because of a critical shift in the goals of education over the last 10, 15 years from a time when the goals of education were access, maintenance, and control.

Getting students into school. Maintaining the school as an entity that we understood and knew that were teaching and learning to place. And controlling the inputs into the school. To an emphasis now on quality and performance and development and responsiveness of the education to the needs of learners.

This is a big shift and we'll be talking more about this shift in time. It's also a time when improving education quality requires much greater attention to alignments and linkages to how things fit together than they did in the past.

And it's because of in this more complex environment that we find ourselves now we need skills and methods and habits of mind to better identify and understand the critical alignments and linkages and to deal with them as we try to structure effective education systems.

To reinforce this point about the lack of misalignments and the complexities of the world that we live in right now, we can think of education in some circles as a story of misalignments and I'm sure this will be familiar to most of you.

But education systems tend to be out of align with the evolving and changing demands of business and industry. And we hear this in country after country where business leaders will question what are you doing with our students?

And they're not coming to us with the skills and knowledge and attitudes and beliefs that they need to succeed. Students without the requisite knowledge, skills and attitudes to both find meaningful employment and to participate as fully responsible citizens and community.

We have students moving from one level in education systems to the next ill-prepared to succeed. So we have secondary school leaders questioning what primary school leaders are doing because the students aren't prepared to do secondary school work when they arrive.

We have university leaders questioning what the secondary schools are doing. And of course we have business questioning what the universities are doing. So there's a lot of misalignment that could be attended to.

We have teachers graduating from professional programs with limited knowledge and skills related to the new teaching and learning methods. And particularly important today limited ICT skills, information and communication technology skills.

And importantly we have ministry structures and processes that are very often out of alignment with the needs of schools. Ministries that are an artifact of a time when the goals and objectives were access, maintenance and control.

When the job of the ministry was to get the components for effective schooling to the school site and leave it to the teachers to do the teaching in the belief that education would magically happen.

We now know that it's a much more complex game than that. And that the work of ministries which were structured to deliver individual components now must more and more become integrating these components, sorry about that, integrating these components and delivering a total package of support and services and tools to the schools.

Now why all these misalignments? Because those of you who have been in education for 10 or 15 years will recognize that people have been talking about system-wide education reform and holistic reform for at least 10 or 15 years and in many circles longer.

But the problem is that most past reform efforts, those even those professing to be holistic efforts, have really not been guided by a systems perspective.

Attention to alignments and integration have been limited. These reform efforts of the past even those titled as systemic and holistic have tended to be component based with multiple parallel initiatives directed by very competent and well meaning people.

But with very limited attention given to the integration and alignment of interventions despite the best of intentions of the project designers. So we continue to have education reform taking place in an incremental and component-based manner.

This is why we talk about now about transformation and not reform. That's why the title of our session is systems thinking for educational transformation.

The realization that we now have is that in most situations radical education transformation is what's needed, not the continuing incremental reform that we've known for the last 25 or 30 years.

That's not because these reforms haven't been successful. They certainly have. There are more children in elementary school, primary schools than at any other time in history with more competent teachers than any other time in history.

There are more people in secondary schools and universities et cetera, but the needs of these students and our needs as a society of what we need from these institutions is changing, and it's changing at an ever quickening pace.

Let me say a word about the increasingly complex educational landscape that I referenced a few minutes ago. As I said this is an incredibly exciting time to be in education although those of you who are in senior leadership positions in ministries or universities or schools will also recognize that it's never been more challenging.

What are the changes that we need to focus on? One is changes in the world of work. What the skills and knowledge and attitudes that the business world, the industrial world, the government sector, NGO sector is seeking is much different than it was before. These changes in the world of work are driving a change in what we need to be helping students acquire.

The rapidly evolving and ubiquitous technology. ICT. Information and communication technologies are radically changing our homes, our businesses, our offices and unfortunately the last on the list sometimes is our schools. And we need to embrace this technology in ways that are going to be useful and help students be prepared for 21st century life.

Changes in the knowledge and skills students need to be able to work with one another in order to make sense of this ubiquitous technology and the information, this constant stream of information that it makes available. They need skills of how to sort through and adjust their understanding based on this information.

There are lots of changes taking place in what we know about the conditions for effective teaching and learning. Later in the workshop you'll have a session with Kate Merseth to talk about instructional core in teaching and learning. And it's dramatically shifting the way we think about how to organize schools and how to organize student instruction.

New knowledge and theories about child development and what it takes for children to learn. The idea of multiple intelligences that some of you may have heard of. That children learn in different ways and that we as educators need to begin to focus on multiple approaches to organizing student learning.

Then some exciting new work being done here at Harvard as well as a number of other places in the United States and around the world on understanding the physiology of learning.

The mind/brain connections. Of nutrition and the brain and the mind. Exciting new material that we have to pay attention to.

So all of these together make this landscape an incredibly complex one and one that needs a new set of skills and a new set of ways to think about and look at and deal with this complexity.

This reminds me just of some quotes that you may find useful. These are some of my favorites in thinking about systems thinking.

You know H.L. Mencken once said for every complicated problem there's a simple solution and it's wrong. So that's to say that some of the methods, the deconstructionist methods, that we've used in the past breaking things up into pieces and working on the pieces may not get us the results that we're looking for, if they ever did.

A couple of other quotes that I particularly like. Insanity is doing the same thing over and over again and expecting a different result. You know, whether it's Albert Einstein or Benjamin Franklin or whomever else they credit for this, the thought is a very good one.

We cannot move forward in education or in any field if we continue to persist in the kinds of reform, incremental and tinkering around the edges if you will that we've practiced up until now. We need something more. We need something more complete.

And as Einstein once said no problem can be solved from the same level of consciousness that created it. There's the argument for we need new ways of thinking and new ways of thinking about the problems that we face. And this is where systems thinking comes into the mix.

So let me talk about what is systems thinking very briefly. Systems thinking has a number of different characteristics. It's learning to see the big picture.

To get above the system, whether the system that you're dealing with is the classroom or the school. Or whether it's a project or whether it's a whole education system. Getting above the fray and seeing the big picture. Seeing all the elements. Identifying the elements.

Learning to see the dynamic complexities among those elements as well as just the detailed elements themselves. So we distinguish often between detailed complexity, the number of elements, and dynamic complexity, how these elements interact with one another. Where the critical alignments and linkages are.

It's about learning to see more than an endless succession of events, and learning to see and understand patterns of defining structures. To see rhythms in the system.

Every organization has rhythms. It has patterns that are intended or sometimes evolve. So the systems in using systems thinking we're specifically trying to develop tools and techniques and methods and a consciousness to constantly look for those so we're not continuously repeating negative patterns. And we begin to learn from positive patterns.

It's about learning to see the short as well as the longer term unintended consequences of our actions. So it's learning to see both short and medium and long term intended consequences but also and importantly to watch for unintended consequences.

It's about understanding complexity. It's about seeing linkages and alignments and interdependencies.

I'm going to show you a few diagrams now as a way to introduce you to the kind of evolution of systems thinking. Some of these will be familiar to you and some may not.

The first one that I'm sure most of you will be familiar with is the general systems theory model going back in to the '30s and '40s. So many, many years old.

But this is the basic idea of a closed system. Closed, relatively simple system put forward. And we have four components to this.

We have the inputs. We have the outputs. The future state that we seek. We have a transition state where the inputs interact with one another to hopefully give us our output. And then we have the feedback idea. So this the basic systems are leading a kind of linear systemic model with some feedback.

The classic example people use here is the idea of a thermostat in a room to either regulate the heat or the air conditioning in a room.

We set the temperature. We tell it what we want. The system takes the feedback from the air. It feeds back into the system and constantly regulates itself.

So that simple system of a thermostat in a room is a very good beginning model to keep in mind. But as we move up there are others.

Now we take this basic systems model and apply it to education as was done for many, many years. This is, although some criticize this as an industrial model and it is admittedly quite linear, it still has utility for us as a starting point.

So here we see in this diagram a list of inputs, a set of processes in which these inputs are put together in a classroom or a school or a project. And then we think of the outputs of the system.

In education we talk about it in several different ways as outputs or outcomes or increasingly more recently as impacts. And these can be split into several categories.

Outputs are employable graduates who can think critically, who value learning, or humane civil individuals and who become responsible citizens.

But the real outcomes we're looking for, the impacts on the society, the reason we have education systems is we want civil society. We want economic and social development. We want new knowledge with which to keep things moving forward. So this simple systems model applied to education has some utility.

And then we have a series of feedbacks in the higher performing systems, which are constantly helping us to check whether or not our actions and the inputs and the ways we put them together are having the intended outputs and outcomes.

Now let me talk a little bit more about this idea of thinking systemically and dynamically. There are a number of tools one can trace back many years.

This one going back into the 1960s. An idea that I borrowed some years ago. The idea of thinking systemically and dynamically when managing change.

Leavitt back in 1965 posited a very simple but very useful and powerful diagram that you see in front of you here now. That's saying that every organization, every system, has four parts.

There are organizations and systems and processes that are put in place to achieve some goal or some work. And on the right hand side we have organizing student learning as the goal. The ultimate goal being student achievement and productive lifelong education and civil society, et cetera.

Then we have people who organize this work. And then we have technologies that we use to do this. And here I'm not talking about computer technologies only. I'm talking about blackboards or books or textbooks or paper or pencil, whatever the technology is that you use now.

What this simple diagram is useful for is when we change anything in the organization, the organization want to stay in balance. This diagram says that if you touch anything, you have to consider the other impacts that this action you take may have.

For example. In technologies in education as we introduce more and more computer technologies and information communication technologies into schools, what are the implications?

What does it mean for the people who we have in schools? What new skills? What new knowledge? What new kinds of people? What new staff do we need?

What does it mean for how we organize student learning? What does it mean for the curriculum? What does it mean for the procurement practices? What does it mean for annual maintenance budgets? What does it mean for information privacy concerns?

So this simple little model can be a very powerful way to constantly remind ourselves that a good idea may have other consequences. Or there may be other things we need to attend to in order to realize the benefits of the next new idea, the good new idea that walks into the office.

Here's a model very similar to the previous model, the Leavitt's model, but elaborated in looking at a school. So here you see a number of the components in a school.

And the school lives of course within the community. So the school's system or subsystem if you will living within the community here is comprised of a number of key pieces. The principal. The teachers and the students. These are the people in the school. And other staff of course.

We have curriculum textbooks and materials. We have technologies. We have the physical infrastructure and facilities. And we have the pedagogy. How teachers and other staff use time, space and materials. These are the key components of a school.

You'll be talking more in the workshop, later sessions in the workshop, about some of these key components. But for us looking at it holistically these are the key components.

And what this diagram says is if we take action, if we plan to take action on any of these, there are some dynamic interrelationships that we need to pay attention to.

That it's introducing as I said the computer to the school or computers in the classroom is not an innocuous act. It's going to have tremendous implications for many other things that go on in the school. For other people in the school and for how teachers use time, space and material.

So this diagram is an attempt to remind us to constantly be vigilant in looking for the interactions and asking great, what does this mean for the teachers? What does this mean for curriculum? What does this mean for the physical space and how I arrange it? So this is an initial systems model of a school.

In the Peter Senge article you'll see a very well developed elaboration of the relationship of the school with the communities and the parents that they serve. So you might want to take a look at that particular model as well.

Here's a model for those of you who are working in ministries or regional education authorities. OK, we have the school as a system but it's really, it's not a closed system because it's got relationships and it's impacted by many other systems and the larger education system.

So in this model here we begin to elaborate the system further and build in the components of the quote whole education system that supports the school.

So you'll see again the kind of the original systems model here. On the right hand side we have the knowledge, skill and social outcomes and outputs.

And at the bottom of this diagram we have a series of feedback mechanisms that we use in order to monitor what goes on in the school, to build the capacity of the school to do the things that we expect of the school to do.

Including on the left hand side you'll see the standards that are developed by the ministry, standards for leadership, for teachers, for how teachers teach, for the curriculum, for textbooks, for technology, et cetera.

So this begins to elaborate a bit more complexity into the whole education system. And you're welcome to take this and elaborate it even further.

Here we have something that is something we might call a systems map but it's really more of what we call a mind map. We're not going to spend time on that today but a mind map is the initial step that you'll want to take and developing your systems models, which will be the assignment that I'll be giving you initially.

A mind map is the initial step in identifying the key elements in the particular challenge or problem that you face or beginning to organize them in a systemic way.

This is the second or third iteration of such an exercise by a group of six senior educational leaders participating in a program here at Harvard several years ago.

This asks the question of what does it take to have quality education was the question here? So the group began with this particular activity in a mind map.

There are other tools and techniques that one can use when thinking about systems. The dynamic systems modeling has been around for many years having been introduced as early as in the 1960s in looking at ecological and environmental systems.

Much of this early work was done at the Massachusetts Institute of Technology, but the tools and techniques developed have now been well refined and elaborated and used effectively in many different fields including education.

Here we have a dynamic systems model looking at, trying to look at the question of school performance. Innovation and school performance. And how do we increase student [performance?]? What are the critical factors in increasing student performance?

In a model such as this you can being anywhere and go anywhere in seeing the connections. But if we look and start with student performance and then map backwards, you'll see that student performance is a function of student ability.

And also in students ability is a function of the curriculum and the knowledge and the training students have had. That is a function of the curriculum and et cetera, et cetera. You can follow this particular dynamic model around.

Another dynamic systems model is an example looking at this problem of exacerbating problems caused by posing stringent external standards.

Now leaving aside the political question of external standards or not, this is an attempt to understand, one person's attempt to understand the effect is of external standards and assessment on what goes on in schools.

Again you can take the time yourselves to kind of follow this model. You can start anywhere and backward map to understand the particular piece of the model that you're interested in.

So the series of slides coming here that you will have access to, but I'm not going to spend a lot of time on. Different ways to think systemically and to work with people in helping them to think systemically.

this first model here is one of the technical and vocational education training system for the country of Kazakhstan developed several years ago for a World Bank project.

It was an effort to try to capture the system as it exists and as it's evolving in the learning's minds. And so this took a lot of work with many different people to come up with a way of understanding their [UNINTELLIGIBLE] system if you will.

You may look at it slightly differently, but can get the idea here of what a system, what this type of a system model might look like.

It's also important in looking at this model and the other models to note the importance of a visual representation as a way of bringing people with multiple levels of understanding and knowledge of education and how the system works to shared understanding. So the visual nature of systems thinking tools is an important of systems thinking.

Here's a model from Lithuania that's done several years ago on a large scale project in Lithuania trying to improve the data for decisions in support of education. Trying to move from an experienced based decision making model to more data driven decision making models.

And what that model might look like and how we might reorganize the flow of data and information. The data information system to improve the quality of the decisions made at the senior levels. And to base those decisions more and more on data. This was I think I said from Lithuania.

Here's a more recent model looking at an issue which is important in many of our countries. Looking at the issue of math and science education and trying to understand why students are kind of running away from math and science in countries around the world.

And the efforts that are underway in the field of STEM. Science, technology, education and maths in trying to get more students to stay in and succeed in those important, critically important topics. So here's a model their team put together to try and understand this problem. This particular model was developed in Kuwait.

And here's a model looking at higher education because I know that we have some participants in the program who are from universities. This [too?] systems thinking is as relevant to your work as to the K-12 people in the group and to the ministry people.

Here's a model that looks at higher education contexts and looking at the impacts of globalization and how the needs of the labor market and public policy and globalization are all kind of aligning or need to be aligned.

So this is a very beginning of a model on the place of higher education in social and economic development. I encourage some of you to pick this up and run with it.

At this point you're probably asking yourself OK, what does it mean to be a systems thinker? Or what are the habits of a systems thinker? This particular slide outlines a set of the habits of systems thinker.

Some of the readings and other sources that I'm providing to you will provide you with ways to explore in more detail each of these. But you can see like some of the key ones seeking to understand the big picture.

A systems thinkers is constantly trying to see the system in its totality. Constantly trying to change one's perspective and see the mental models that work that are driving people's understanding of the system.

Constantly trying to surface and test assumptions to try and find better ways of doing things. Constantly on the lookout for unintended consequences that might emerge, OK?

And most importantly seeking to understand how the system structure works so that we can identify the highest possible leverage actions. Those actions that will have the greatest positive impact on the achievement of our goals and objectives.

I've been intentionally broader in this introduction than I have been deep because you can through the various materials get more and more into the depth as you'd like.

I want to encourage in this week as well as in the weeks that follow to work together to talk about some of these things that we've introduced to you today.

I want you to take time this week to explore the internet. Beginning with the sources that I provided to you, but following the paths that they will lead you to, to find more and more on systems thinking. And systems thinking for the particular problem or issue that you may be facing.

I provided you in the materials that follow with some places where you can download some free software for those of you who really want to explore systems thinking and get more involved in the how to structure the system dynamics models for example.

In the weeks that follow I hope you'll use some of the ideas introduced today and the elaborations you'll find in the [right?] readings and the materials you'll be exploring this week.

To use systems thinking as a perspective with which to reflect on the work that my colleagues will do with you in the remaining three weeks of the program.