SIEMENS | Stiftung

“STEM education for the 21st century”

Speech of Dr. Nathalie von Siemens,
Managing Director / Spokesperson of Siemens Stiftung
at the “International Conference on
Inquiry-Based Science Education” in Mexico-City,
04.12.2017

[OPENING]

What if I told you that all of us sitting in this room, we have all that we need to solve all the world's problems?

What if I told you that in every classroom in every corner of this world children have everything they need to solve all the world's problems?

Ladies and Gentlemen,

I am not going to be formal; I just wanted to thank Colegio INNOVEC for inviting us to this wonderful place and to this incredibly inspiring conference. I also want to say hello to all who follow us online – I think it's from 5 or 6 countries.
So ladies and gentleman – amigas y amigos,

[GLOBAL QUESTIONS]

Technology is undeniably the most powerful driving force behind human development. Humans invent technology to live better lives. Some of these technologies provoked revolutions. We were cold, so we invented fire and more of us survived. We were hungry, so we invented agriculture and many, many more survived. We wanted to learn, so we invented letterpress printing and people understood. Then we arrived at the 19th century. We turned electricity into power. And that was the beginning of the industrial revolution.

That revolution introduced industrial production which is based on three simple principles: standardization, memorization, and repetition. Industrial production means creating or assembling large volumes of identical goods, with very little deviation from the norm, as quickly as possible. This is a complex and difficult task and results in a very broad offer of products. In industrialized societies, the majority of people can participate and enjoy this offer. Because for the very same premises of standardization, memorization, and repetition the majority of people can also participate in the production process. Industrialization offers a large number and variety of goods, but also of jobs. And with jobs the majority of people enjoys personal development and financial security.

This is why in many so called developed countries, industrial value creation forms the basis of the society's wealth. This is also why many so called developing countries aim to establish industrial value creation within their economies. Because exporting commodities and natural resources usually does not allow the majority of people to participate in GDP wealth in the same way. This is also why we all believe that STEM education is of vital importance in a society. In industrialized and in industrializing societies STEM education is the door opener to wealth, rewarding jobs, and political maturity.

Industrialization was and is a blessing.

But, with the good, came the bad.

Industrialization caused a rapid paradigm shift in how people work. Those first generations caught up in the shift suffered from brutal working conditions and poverty. And of course, we

still struggle to find a solution to problems we inherited from the industrial revolution: man-made environmental destruction and climate change. But the social questions of the 19th century have been solved. We introduced laws to protect workers and to secure social welfare. And we established compulsory schooling, as well as a new way of learning suited to the industrial age.

But now we face the next revolution: digitalization. The way we work and live is undergoing another paradigm shift. This will create new blessings for societies. But again, with the good, probably comes the bad.

[RACE BETWEEN TECH AND EDUCATION]

And there is a reason, that technological paradigm shifts always include a downside. As Andreas Schleicher from the OCED tells us, it's the 'Race Between Technology and Education' that creates this downside.

Here you see two curves:

One shows the development of technology. The other shows the development of education.

The development of education unfortunately lags behind technology.

This isn't necessarily anyone's fault – it is hard for a well-established system to adapt to disruptive developments.

Still, when the development of education lags behind technology, we feel it. We feel social pain. It was the pain people felt during the industrial revolution before we implemented regulations on work and introduced an effective way to learn. Only when the curve representing development of education is ahead of technology, do we enjoy social wealth.

That's because the education system provides knowledge, competencies, and attitudes that prepare us for our lives. And that includes helping us to become part of value creation – to enjoy the economic benefits of a new technology.

Today, there's another education gap to close. Otherwise, the same suffering that came during the great advances of the industrial age will be repeated for the first generations of the digital age.

The twist with digitalization is speed: the unprecedented acceleration of change. I think the legislative process moves too slowly to spare us from social pain, at least initially. We cannot even agree on regulations on the long-term consequences of the previous revolution in industry: namely man-made environmental destruction and climate change.

I am convinced: closing the gap between technology and education will be the key.

So what can we learn from the last time we closed that gap?

The educational gap of the industrial revolution was closed by introducing a new learning based on standardization, memorization, and repetition. The premises of industrialization itself. And

this is the school we still have today. Pupils mostly sit in the same direction, are given identical tasks, and expected to produce identical results. Look at standardized tests – it's right there in the name: 'standardized.' To us it represents educational justice – all learners are treated equally, and results are objectively comparable. And we can learn from OECD that in many countries – like in Germany – we still focus on memorizing and repeating.

This wasn't a bad system! It worked well for the age of industry, it helped people to learn what they needed in a life marked by industrialization.

Today, digitalization is already making its mark on the way we work. We don't want standardization and conformity; we want mass customization and batch sizes of one. The repetitive tasks are already being automated. And artificial intelligence is doing many tasks much better than humans can, such as pattern recognition for cancer screening.

The ability to do exactly as we're told is losing its relevance. In the digital age, divergent thinking, skills in creativity and innovation are in demand; the ability to work for the well-being of others in a social capacity cannot be automated; the dexterity required for precious craftwork makes us superior over robots. But those competencies are not the ones our kids are focusing at school.

Our kids are being prepared for the past revolution while the next is already happening.

[DIFFERENT ACTORS HAVE DIFFERENT ROLES]

Obviously many of the lessons we learned from industrialization are still relevant to all societies that rely on the benefits of industrial value creation. Many so-called developing countries are working hard to help their people join the industrial age. But the next revolution is already happening and we need to make sure we keep pace with digitalization. Both are possible, I believe, but it is a matter of deciding WHAT do we have to do, and HOW do we achieve it. Let me start with the HOW.

The digital revolution will impact us all in some way, so all parts of society need to be part of the solution. That means cross-sector collaboration among the private sector, the public sector, academia, schools and universities, civil society, and foundations.

Foundations do not replace talented teachers, passionate politicians, or resourceful entrepreneurs. But, a foundation has the freedom and thus duty to experiment with new approaches. Charitable foundations are neutral and credible, free of lobbying on behalf of one company or industry, working instead for the good of society as a whole.

And foundations can build bridges. Bridges from one sector to the other. And help - as Leopoldo said – to defy the prejudices against the private sector or also against the public sector and institutions. Foundations can help build trust. But they can also build bridges to the fringes of societies.

The distance between the fringes of society where social questions become first and most visible and the institutions that can implement systemic change often seems quite wide. And sometimes established systems do not realize the innovative power of these fringes of our societies. But this is where foundations come in. Our networks extend in both directions – from the far edges of society to the institutions and back.

Foundations can build bridges, but a bridge is no good unless people are using it. In both directions. Foundations have no impact without strong partners. These can be business leaders, with their access to networks and knowledge and financial resources. Or scientists and academics contributing new concepts. Operational partners on the ground. And we couldn't scale our best practices without collaboration with regulators and institutions.

At our foundation, Siemens Stiftung, we are lucky to have strong partners in all these sectors. That includes INNOVEC here in Mexico. We've been working with INNOVEC to implement one of our programs, Experimento, in Mexican schools since 2014. We collaborated on a new "Energy and Environment" Unit based on INNOVEC's Inquiry Based Science Education Program (SEVIC). Another new unit based on health is being developed as well.

We also count the company Siemens here as our partner, who is so kind to provide networks and communication and helps as in all ways they can. I just learned that the gas-lighting system in front of Colegio Nacional has been built by Siemens 100 years ago – that's a nice learning for me today as well. We're also fortunate to count UNESCO as a partner. We worked with UNESCO on developing an education toolkit for teaching and promoting sciences to pre-school children in Mexico, with an emphasis on gender. The report on our findings is going to be released tomorrow, and we had lots of help from INNOVEC on that project, too.

Yesterday we heard from the Medellin subsecretary for education, Jorge Rios, on STEM + H, where H stands for humanity. Our very close work with him and his colleagues at the education ministry have led to very promising results in reducing aggression in children in Medellin, which I will share in a bit.

Universities, foundations, public and private institutions in Mexico, Columbia, Chile, Peru, Bolivia, Brazil, Argentina, Ecuador… all our partners in Latin America and beyond play a role in addressing the HOW question I mentioned.

[FROM FIX TO CREATE]

And that brings me to the WHAT. WHAT are we going to teach our children to help them play a role in the industrial age AND prepare them for the digital revolution at the same time? I believe that STEM education will play a decisive role in this, creating industrial AND digital value. We're already collecting exciting experiences with our partners that will help us define STEM's role in the digital transformation.

I mentioned our work with INNOVEC on Experimento before – it focuses on what I think is the first step in changing education: inquiry based-learning. Connecting STEM to real life, and teaching children how to think like scientists.

With Experimento, we tap into children's natural curiosity and unlock their enthusiasm for science and technology through age-adjusted experiments.

Experimento happens in the classroom. It's not additional to what the teacher has to do anyway. Experimento adapts to national curricula – so it is part of the formal education chain. Experimento includes teacher training and free online teaching materials. The role of teachers cannot be overestimated. They have one of the most important mandates in the society. But we

need to support them better for this mandate. Because it's easy to teach science poorly – Experimento gives teachers the tools they need to teach science well. Because with Experimento the teachers not only teach science, but start thinking like scientists, too. Together with the pupils.

Experimento is being used on three continents, in 12 countries, and in four languages. So far, our age-adjusted experiments have reached nearly a million children worldwide. That includes about six hundred fifty thousand (650,000) in Latin America. And we are really proud of that.

But this is not enough.

Despite efforts and so many initiatives around the globe in STEM education, our - and I say 'our' to all this initiatives – our impact is not as great as we had hoped. Many children still have no access to high-quality STEM education – apparently, our advocacy work has not yet convinced all decision makers. STEM professions are not as appealing to young people as we had hoped. This is especially true for young women shying away from STEM jobs.

But these women can teach us something.

Research has shown that women gravitate toward professions if they understand them as relevant for society. If the jobs have social value. Perhaps it is not enough to explain to young people that STEM is economically vital, and that a skilled workforce creates wealth. Maybe STEM needs to resonate on a personal and emotional level, too. Maybe in spite of our efforts with inquiry-based learning we have still given technical answers to emotional questions. And the question: "what will I do with my life, who do I want to be as a person?" is a VERY emotional question.

So I believe we have to re-energize the STEM discussion and make it relevant. Make it count for the lives of young people.

We're seeing that happen in Medellin, as I mentioned before. Teachers there using Experimento have reported lower aggression and higher self-confidence among pupils in their classes. And just to give you a bit of context – we are working in Medellin with not well funded schools in the difficult areas. With the families that suffer. We don't have enough research yet, but it seems logical that inquiry-based learning done in groups – a core component of Experimento – contributes to these improvements in behavior. And STEM in itself adds fact orientation which seems plausible to help children learn to argue and change perspectives. That is the base of all social skills and of communication. This was always an implicit effect of Experimento – we've now made it explicit by adding values to the STEM education equation. We focus on values relevant to the learning process, such as initiative or ownership of ones learning process. But also on object related values.

Now, when it comes to values, a teacher cannot claim to have the right and wrong answers. Self-confidence, respect, tolerance, a sense of responsibility - also with regard to the environment, and solidarity cannot be evaluated on a standardized test. Instead, Experimento is using dilemmas – situations where learners are forced to decide themselves based on their own moral evaluation. And decision making is a skill best practiced using real-life scenarios – like the ones we examine in STEM subjects. First observations confirm that this kind of value education makes STEM interesting and attractive.

So let us take the question of values and real life one step further. Climate change is real life. I think we all agree on that, and I think we all agree technology will be part of the solution. Our children need to know this – they need to know STEM is the key to saving the planet, to preventing human suffering caused by rising sea water levels, fatal draughts, and deadly hurricanes. With a growing global population and finite resources, we need to help children understand WHY it is important to live sustainably. And that can make STEM education attractive, because young learners see: it has a purpose. This is why Education for Sustainable Development – ESD – also has an important role to play, and not just for environmental issues – it is important to integrate economic, social, and cultural development, too.

Finally, there is another aspect that can make STEM more relevant in industrializing and in digitalizing societies. It boils down to a single letter – the letter A.

If we add the letter A, which can stand for 'arts,' to STEM – we get STEAM. Something we know from the beginning of the industrial revolution: steam powers progress.

(This acronym works quite well in English – in German, we say MINT. With the "I" we address "Informatics", not irrelevant in times of digitalization. The word for art "Kunst", begins with K. Not sure how we're supposed to work a K into the word MINT. Maybe you'll have better luck in Spanish.)

For me A can stand for much more than the arts. A as in attitudes or asking, awareness or abilities. A as in action. STEAM is really about the creative process, which we know from the arts and humanities and which is precondition to all innovation. At our foundation, Siemens Stiftung, we have always believed in the social value of artistic creativity. We have a program called Changing Places. Artists come to urban spaces and abandoned buildings in cities, and through their inspiring and touching work, shape a different story about a neglected place. And it is this new narrative that can be the first step for people to create their own solutions to local problems. Artists help us change perspective and enter into a dialogue of all stakeholders.

(In fact, we're looking forward to shifting the urban narrative right here in Mexico with Changing Places in 2019.) We just received the encouraging news that the ministry of culture and the Goethe Institut México will be our partners for this wonderful project. But back to STEM.

Shifting the narrative through STEM education can be done if we include focus on the competencies and attitudes that are fundamental to divergent thinking, creativity and solution orientation. New methodologies like design-thinking are promising also for school education.

Inquiry based learning, STEM related value education, ESD, STEAM, all these approaches have one thing in common. They don't mean that we stop to teach Pythagoras in math or the law of the conservation of energy in physics. But in addition to teaching knowledge they help educating competencies and they help to acquire attitudes. They connect STEM to the narrative of children's lives, their personal and unique story. And to the narrative of our societies. The "old STEM" was about fixing, namely fixing a problem called the lack of skilled workforce. The "new STEM" is about creating, about creating a way of living. STEM is not anymore just something we have to master, it becomes part of a much bigger story.

The ideal of the industrial age was the perfect machine. Don't get me wrong on the following thought, my whole family background has a lot to do with perfect machines, I love perfect machines. But over time humans have not only loved and used their perfect machines, they have tried to BECOME like them. Standardized and repetitive and thus efficient. Now the ideal of the digital age is probably the perfect algorithm. And we worry that these perfect algorithms might outsmart us. That makes us again competitive against our ideal, we try and beat the algorithms, and we play check or go against them. But to beat a perfect algorithm, I must BECOME a perfect algorithm – do we really want our children to become algorithms? I would prefer giving all children the chance to develop what they are good at as humans.

[GLOBAL QUESTIONS, LOCAL ANSWERS]

And this starts locally. All education is local. Children from Baja California grow up in a much different environment than children who grow up here in Mexico City, or in the Andes, or in Germany. Part of making STEM relevant in children's lives is helping them learn about what they see around them every day. But that doesn't mean local knowledge doesn't transfer, there is plenty we can learn from each other.

The digital revolution is changing the way we work. In fact, how we work TOGETHER is changed by the digital revolution, too. It starts with the possibilities to interact through social media – and again hello to everybody who is following online. And if digitalization will require us to focus on divergent thinking and creativity, we will have to go from functional interaction – like well-oiled machines – to co-creation. Across sectors and across borders. This is more than establishing interfaces to roll out existing concepts. We all have to learn from each other and co-create something, which is more than the sum of the different perspectives we initially brought to the collaboration.

Siemens Stiftung is grateful and honored to be invited to be part of this exchange and contribute to this fascinating transformation. And the more we learn about the context and circumstances of each of our partners, the more impact we can create.

Here in Mexico, we are honored to work with INNOVEC and UNESCO and have so much more to learn about how new STEM approaches can perhaps be part of the solutions in this country specifically. Just look at the learning curve of Mexico in PISA.

We want to learn much more about the emphasis on the development of "territorio" in Latin America, small ecosystems with focus on how to translate education into (entrepreneurial) impact in communities.

Escalation fueled by strong men is on the rise in the world, while de-escalation and a collaborative approach on global issues is in decline. The Colombian peace process is a welcome contrast, and its impact on Latin America can teach us so much. And a lot have to be done to make the step from a peace treaty to actually living peacefully together.

And we have so much to learn about the Pacific Alliance. As you know, education is an important part of the treaty. And we see from all our work that not only cooperation across sectors is necessary to develop our educational systems further, but also international cooperation. But while we are used to international dialogue in politics, in business, and in education at the university level, there is very little international cooperation at the school education level.

So, why not bring all our networks together and view the Pacific Allianz and its associates as a platform? A platform of co-creation on inquiry based learning, STEM and values, ESD, and STEAM?

[CLOSE]

So coming back to my initial questions: I think, we can see that all of us sitting in this room do have all it takes to solve all the world's problems. Because we have all the insight and all the necessary networks to help understand our children that they have all it takes to solve all the world's problems.

And that is our job.

Thank you!