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Speaker 1: So my to begin with, I would like to know start with your understanding of higher order thinking skills or what kind of higher order ability do you expect in an interdisciplinary environment from a student's?

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Speaker 2: Oh, OK. you want how many answers to the question. So. I guess, you know, there is all the 21st century competencies are there for me. If you want to be able to address challenges, you have to be creative, you have to be cooperative, you have to have critical thinking, you have to be able to. Communicate with others, understand others have critical thinking, but in a way that is constructive and that creates more conflict than the misery. And yet you have to be able to express yourself. You have to be able to take criticism. You have to be able to. Redefined the question that you've been asked. So maybe one of the most important skills that is often not considered in education settings where, you know, students tend to do what they're expected to do rather than, you know, question. There is one way of phrasing this, which I like by my friend Elgano Whitney was they, as you may know, the founder of the European Research Council. She's like that. She's a sociologist of science, and she launched this. And she says that you know, which we need from students is for them to be competent rebels. OK, so you need to the rebellion as well as the competency. And so you need to have these two things which are very often considered different and nearly opposite. And so you need to be able to convince your teacher that you are competent and you need to be able to rebel against your teachers preconceived ideas. At some point, you have to be able to challenge them. And so, you know, I mean, good students is able to go much beyond his master, whereas, you know, most teachers like their students to remain under there. And so it's also requires competency in the teachers or the mentors themselves, which may be the most critical, which is to accept that sort of rebellion that you know your students would surprise you. Students would challenge you. Your students will go much beyond what you know. And that's and then you can be proud of them. But you know, you have to to learn to do this. And so I think, you know, it's nearly the least natural. Maybe the mentor, I mean, the students has an interest in being critical in being creative in the cooperatives, even in all this that the teacher needs, you know, some sort of an ability to to accept these sort of challenges. And that might be the most limiting.

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Speaker 1: Great. Thank you. Thank you very much. I mean, definitely that gives a different. Yeah, the concept or the element of rebellion is gives me another perspective towards the skills and competencies.

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Speaker 2: One example that Elgano told me in the Austrian Empire of the 18th century, there was an empress, which, if I remember correctly, was called Maria Teresa or something like this, and she started to give a medal and she created an order with her name for those that succeeded in battles by refusing to obey orders. If there are creative, competent rebels that win. Yeah, know that's what you want. Well, and I mean, the dominant model is, is is everyone lose. Okay, so you need to have people that are, you know, rebellious enough and competent enough to invent something which can be a win win for humanity and the planet, whereas the current model is, you know, we are going to all lose.

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Speaker 1: Yeah, but I think I could not have gotten better view our analogy for this. So thank you very much. I think the power in my classrooms as well. I could use this. Yeah. Yeah. Concept of a medal or a great medal. If any student goes against the current model and creates another one that is much more suitable.

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Speaker 2: So basically the movie three idiots? Yes. And so you can show that movie to the students and say, Okay, that's this is who we want you to become. You know, you want you to be Ranchos or, you know, competent rebels and you name it the way you want, but that's the sort of prototype you want.

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Speaker 1: Indeed, indeed. And one of the goals is to actually prepare students that kind of mindset. And my research is all about understanding and hypothesizing what kind of limiting factors are there in order to have that breakthrough. So my question is more precisely, as you've mentioned, many an array of skills from, you know, communication cooperation, critical thinking, so on and so forth from rebellious. Now I'm just narrowing it down to just mental abilities are thinking skills or academic skills for that matter in the context of interdisciplinary field. So as opposed to disciplinary practice or disciplinary approaches in interdisciplinary approaches or practices? **What kind of mental abilities are thinking skills you think are necessary?**

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Speaker 2: I think one of them is some sort of trust because. If you are interdisciplinary, you have to have the confidence to defend your perspective against someone that, you know, comes from a different discipline and you have to be able to trust the other when they say something OK? **And only if you know there might be challenges, you may not agree. And it's like this elephant and the blind man. You know, each discipline is watching a different part of the elephant or of the complexity of the problem.** And so you have to be able to communicate with the others like the blind man, **but you have to be able to trust when they see that you don't see it because you don't have the skills to understand everything that they know.** But you should understand enough to. To collaborate and to challenge and to decide what it is that you can do together, but you have at some point to trust some of it in the same time you want them to trust you. So you have to be trustworthy, which means that you have to be very solid singer because you are the representative of your discipline and of your skills. So you had to be sure enough of what you say to be to convince yourself and then convince the others. And you have to be humble enough to know that you know this Japanese proverb that says, you know, **none of us is as intelligent as all of us,** which is what is the elephant and the blind men with of saying it in the Japanese context? But you have to know that, **no discipline is as intelligent as all disciplines together. So you have to have this humility. You have to be proud of what you know and humble about everything you don't know.** You have to be able to argue for your perspective that should be taken into account for the overall understanding of the elephant or the complexity of the problem. But you have to be able to be very humble and know that you know your discipline cannot solve this on its own. **You need the intelligence of the others. And so this this mixture of**

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humbleness and openness and in the same time, you know what you know, it's know that you don't know so many things. Yes, indeed. Very important.

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Speaker 1: Yeah. So in a sense, the humility that you develop based on this is only a piece of information that you know about the world, and there is so much to learn, obviously, in other disciplines. How do you think students can develop that attitude or understanding or what limits them, if they do not possess them already? Or what makes them think that they know everything? What could be the reason underlying reason for that? Not so humble attitude?

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Speaker 2: I mean, to some extent, you are less and or when you are not sure of yourself. So, you know, in order to protect yourself, you you are close to two challenges because if you're if you're confident enough in yourself, then you accept to be challenged by others. But you have to have that right set. And I think to a large extent, what is maybe one of the key things that should be taught, at least, you know, that's the way I discover a lot of these things on myself is to understand what's cognitive blindness or cognitive limitations. So there is also just a little exercise that we do. You know, at CRI, you probably have done this zoom in and zoom out. There is other things besides like, you know, the basketball and the and the teams, and you have to comb the basket and there's the gorilla passing. I feel that test miserably. I didn't see the gorilla passing. And for me, that was, you know, a revelation and an allegory allgorilla in a way. And it's for me the moment when I realized that, you know, when I concentrate on one issue, I'm going to miss so many things and that, you know, how many gorillas did miss in my life prior to this and even estimates because, you know, you can see only one gorilla at a time at most. And and but you need others that you may have a different perspective. And so for me, that was I'm not sure I would have created the CRI without having failed at Gorilla experiment. It's a very easy experiment, you know, and any clever student that believe that he can be concentrated and and compute, these numbers of basketball passing will miss the gorilla and then it would have to become a little more humble.

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Speaker 1: Indeed, and I certainly also remember one of the exercises that I did with students is to show them the limitations of the brain, which is to, I told them to compute what is one over two multiplied by three over four. So they had to take a little more second than computing 20 versus 20 to 40. So it showed that the limitations that you have in your brain plays a lot of yeah, influences a lot in how we can understand the world. So thank you very much, actually. I mean, kind of a shared a similar view on these things. So my next question is basically as a kind of a follow up in terms of you've already talked about challenges for teachers. Challenges for students. For example, a well motivated interested student. Apart from those motivational factors, what could be challenging or what are the challenges that may limit students from getting are developing such high order abilities in an interdisciplinary sciences?

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Speaker 2: I see that, you know, one of the common drawbacks in students is you leave everything that, you know, teacher says in the textbook says, and that, you know, everything

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is written in. And I remember the first time I read a scientific article and I I could see, you know, that it was not every scene that was written in this article was true. It was sort of a shock for me. And, you know, understanding that there is a generational with the goals, the day science and night science. So it's there is a very nice little text by Francois Jacob was a novelist, a French Nobel Prize winner in medicine that, you know, discovered the upfront and genetic regulations back in the 60s and in what Francois Jacob was saying in a very poetic text, I'm sure you can find you should look for Francois jacob night science. You will find this text. And you know, I quoted him a lot 10 years back, we even organized an event that I call night science in his memory because he died shortly around that period. And basically. You say day science is the science that knows everything is the science of textbook is the very impressive science is the science that's, you know, you have to master if you want to pass exam and so on. And night science is what happens when you don't know and you're exploring the unknown. And so you're in the dark and in the dark, you know, no one sees anything. And but there is even a little sparkle or a little match that can be lit. Then suddenly, you know, it's like a firework, you know, and suddenly it's it's fantastic. And so you have to to realize, you know, the relationship between day science and night science. So day science again is textbook know-it-all and night science. It's, you know, open challenges. And, you know, I'm lost and and very often for students that are good in day science, you know, they may feel completely lost in science and they may not even understand this. And quite a few of them are sort of somewhat disappeared there. And to some extent, there is a difference between being an engineer and being a researcher. And, you know, I was trained as an engineer and it took me some years into my Ph.D. to understand this. And and one of the transition points was reading, I think, a French 19th century scientist Claude Bernard that and we considered the father of French physiology research and. Basically, what Claude Bernard was saying is that when you do an experiment. You have to ask, is it black or white? OK, you have to ask precise questions. But when you look at the answer, you have to be super humble. And if the answer is neither black or white, but maybe your red with yellow striped, you have to accept the challenge of understanding why stripes was red on yellow and you know, and with the regularity of the strikes. And is this reproducible and you have to be willing to address the the surprise. And in a way, an engineer usually doesn't like surprise. You should build a bridge or any artifacts as an engineer. And if your artifact doesn't work, if your bridge collapse, that's always a bad news for an engineer, for a researcher. If you find a new way for bridge to collapse, that's a new phenomena. That's a surprise, and that's an interesting question. And so that's for me, the main difference between an engineer like a doctor know they want success. They want to save lives, they want to build bridges. They are a goal oriented researcher, is, you know, a unknown oriented and they want to explore and and they are ready to go in any direction if they are really humble. And if they are not driven by, you know, a discipline or funding, but you know, they are truly exploring, then you know, they don't know where they're going. And they may take a different route because, you know, it's red with yellow stripe and then they have to to start working on the stars and stripes or whatever.

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Speaker 1: Indeed. Thank you very much. I mean, that was very enlightening to see, especially I recognize my mindset as well through this explanation because I myself do not

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like much of the surprises. I like to know precisely what would be the output and at what accuracy I would be able to predict such outputs. Yeah, maybe it may take some more time for me to get the idea of getting surprises and appreciating surprises all of a sudden. I hope I'll get better. So, yeah, and I would like to now move on to the next question, which is on interdisciplinary in itself. So we have been talking about the skills that are related to are needed for interdisciplinary practices or scientific research altogether, for that matter. As a founder of an interdisciplinary center, **how do you define interdisciplinary research?**

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Speaker 2: I mean, for me, **it's doing things that you cannot do within disciplinary boundaries, so it's more by exclusion** that I tend to define it. And so in a way, what I try to do, I create is or even in some of my personal research, but certainly for the students is to have a place where you can do things that you cannot do in disciplinary settings. And there is many things you can do in disciplinary settings, and they are very good that if you want to do something that you know, does not fit into the box. So for me, to some extent, it's the box. For those that don't want to stay within the box, you see, because you have to sneak out of the box. So everyone say about this and you know, the free dots and the nine notes, et cetera, I'm sure you know these things, but you want to have a place for those that you know, are not comfortable with boxes. And if you want to address a real world challenge, it's very likely that, you know, if you want to address the climate, you know, the arrival of AI or robots or or the arrival of the COVID or, you know, any major challenge that human society face, you know, there is no discipline, that has the answer. Hmm. **And so you will have to bring, you know, all the possible tricks and knowledge and methods that you can bring in order to make progress.** And you have to be very candid and say, you know, I don't know everything. others know some things. And, you know, maybe none of us as the complete answer. But, you know, coming together, we can do some things that none of us could do alone. So interdisciplinary approach is, you know, **doing things that no discipline can do alone.** And so you have to have this, you know, **dose of humility** to begin with in in all the actors that I was mentioning before. But I think that. And, you know, to some extent, the there is I think even the Media Lab was defining themselves as a disciplinary, or sometimes we call it undisciplinaire, which is no discipline. Mm hmm. So, you know, again, what matters is not because disciplines in the. I don't know if you know this. By default, is **the obeying, you know, the physical discipline,** child or discipline dog or discipline horse is is, you know, obeying the master and only the master and will be the follower, the disciple of the master. That's that's the original word. And so if you want to explore completely the unknown maybe the disciplines are providing you with some methods, but probably not all methods. And so I think different methods and maybe inventing your own methods on the way is the best way forward. So that's that's what we try to build basically is a space for for these sort of things to happen and and for them to happen in a way that is legitimate enough. university research, as you know, its own sets of rules. And so being able to do a Ph.D. or a research project that goes beyond what the classical roles of given disciplines do is very important, especially in France, where, you know, in every country you have a fight between, you know, the disciplines and interdisciplinarity. But in France, you have to convince both locally and nationally. So you have a sort of a double conviction to be able to make. And so that's what we're trying to build is a safe space for those sorts of exploration.

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Speaker 1: Great. And yeah, I'm very fortunate to be one of those cohorts and who have benefited from such place where we're unable to, who was unable to actually fit into the boxes. So, yeah, and I'm very happy about the journey as well. And my question is more now related to kind of a paradigm of science that shapes young minds even before entering their undergraduate studies, before entering their masters studies. So if I take an example from a book that I read that says Map, a street map is a representation of the existing world. Likewise, all the scientific understanding that we create is some sort of model, theoretical model or a practical model of the real world in some way that resembles more appropriately or accurately what the real world is all about. But what students does? Obviously, the map, the street map cannot give all the important and necessary information from the height of the building to the broken staircases, et cetera. There are so many things that cannot be observed using just a map, but it is obviously a fair representation of the real world like scientific models. But then students, when they go to science or go through science, education and their education methods or education experiences, they are sort of develop an understanding that this is an external are the direct reality of the world. There is probably nothing more to add when they read, for example, Newton's law to understanding of the DNA. Their mindset is all about, OK, this is what DNA is all about. And without understanding that there is much more to it. My question is that given that hypothesis, for example, based on what I have actually observed and read, how do we think we can overcome this problem? Because it is probably also very related to what you mentioned about having humility and understanding other perspective that there is much more to it. And so how do you think we can overcome this challenge?

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Speaker 2: So I think here history of science is very useful because, you know, there is so many and so you know, to my school and others have been instrumental in ensuring that even great scientists that are very great minds are the problem to understand the next paradigm than the one that they contributed to discover. And so I think that there is an interesting I don't know if you read the Thomas Kuhn on scientific revolution, but one one of the example we gave that kind of stuck to my brain is there is a set of cards that you know, you pass at high speed and no one noticed that a few of them are not the classical cards because there is a three of heart that is black a four of spade that is red and at high speed, no one noticed. When you slow down, more and more people will notice, and there is some people that whatever the speed will never notice it and eventually they'll get mad and they say, Oh, I've got something else to do. You know, I've got an urgent call or an urgent need, and then they'll run. And so. There is this tendency of students to to I mean, every human brain, you know, we are there to to look for patterns. And then, you know, that's a shortcut for forfeiting everything. And then, you know, every card as to be one of four type and something that doesn't fit in, this is very hard to apprehend or, you know. And we are all different on this. But you know, we have some difficulty there. And and so being able to to accept this and to some extent, understanding that, you know, there is a domain of validity of of the laws of Newton that, you know, we should go beyond the laws of Newton's validity. Then you enter into Einstein laws of relativity and others. And so there is this tendency of understanding that this is a first approximation and as a first approximation, it's a good enough representation of reality. But even if you don't go for Newton, you have to realize

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that you know there is the air resistance and so on. So in the real world, you know, there is going to be. So in theory, theory works, but in practice, theory often fails. And that's and so I think that the best lesson I learned from the Nobel Prize winner in physics that it was a French guy and he gave a lecture when I was young engineer student. And he basically told us, you know, do experiments. OK. Because any say when I'm in the US, I tell students do theory, but when I'm in France, I say people will do experiments. And you know, one of the only thing that I really want students to do at CRI is to do experiments and to be able to go back and forth between the two because the theory helps you, you know, at a conceptual vision of the world and as some generic understanding. But the experiments can tell you, how wrong, you are and your theory and and will force you to revise your assumption and be, you know, open to this, you know, red with yellow strikes when you ask black or white or whatever. And so you have to be able to go back and forth. And again, it's all sort of a humility lesson. But being able to build seized by your own hand or, you know, go make your hands dirty and so on quickly, you realize that you know what you had in mind, and reality is very different. So even, you know, mathematicians have come to CRI, you know, how to do experiments and experimentalists have to, you know, find a way to understand what's the model with so data? How do you analyze them and you make sense out of them? And so?

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Speaker 1: Well, great, thank you, I could be listening, I mean, forever, and it was very nice to have that understanding. Thank you very much. I'm almost done with the questions. I have just a couple of more questions which just be very brief as well, which isn't the concept of reflection and metacognition. So are you familiar with the the term metacognition itself? Yes. So if you're familiar, then reflection and metacognition kind of probably go hand-in-hand. How do you think the significance of such skills are? How do you think these skills could help in the upcoming generation? Are they significant? If yes, how can we develop such skills in students?

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Speaker 2: I think you can be again, very practical with this, and what's known is that developing. Reflexivity is the best way to how to learn and and you can do it with relatively simple things like, you know, inviting students to reflect on, you know, when they learn best and, you know, make them realize that maybe by doing little experiments in themselves that when they don't sleep enough or they drink too much or their brain doesn't work as well, you know, when they're stressed, the brain starts to block. And and so progressively realizing that you know your your body is not a perfect computer is just, you know, biological organism that has an historical genetic makeup. And you know, also that emotions and and so on, and that can make you completely blind to differences. And so, you know, opening the black box of your cognition and developing your cognition and developing the reflexivity on your own learning and on your own failures in an is a way to learn from your mistakes and maybe avoid the next set of mistakes that you do it. So it doesn't, you know, lots of people are afraid of mistakes, and mistakes can be a lesson if you have enough flexibility, if you have enough metas cognition to start understanding that next time you have to do things differently. And that's true of individuals. It's also true of collectives and collectives, and not to have a lot of complexity already, individuals, it's a problem. But, you know, why did we do collectively blunder? Maybe we respected too much authority. Maybe

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we didn't listen to enough voices. Maybe we were not taking the time to take into consideration all of the data, all of the information, maybe there was some, you know, subtle signal that we've ignored. Maybe, you know, we didn't check enough. So I mean, learning or learning as a collective as well as an individual is a key in. Especially in the age of machines, because, you know, if you start seeing the limitations in your own brain, then you can also see the limitations in the machine. So of course, the machines, you know, compute better than you. But the machines will never take as an input data that you do not fit in, whereas you might have a gut feeling. It's, you know, maybe all the data is there, but maybe there is still something missing. And maybe it's the ethics of the problem that was not taking into consideration. When you look at the number of scientists that committed suicide a few years after their discoveries were successful. Sometimes it's suicide because, you know, they got their theory wrong and they were proven wrong and so on, and so, you know, it's sort of a social failure. But sometimes it's the ethic The unethical use of their discovery that make them commit suicide. And some of them did it for the meter bombs, other did it for the plane or did it for chemistry or for a variety of sins because you can do a nuclear bomb, you can do an airplane that to send bombs, you can do a chemical weapon, you can do all sorts of things. And, if you are unaware of other dimensions, if you are not developing enough reflexivity of not only the way your brain works, but the way society works in the way you know, some people might choose your discovery in ways that you had not anticipated. And so it's it's even, you know, higher level of reflexivity which are not just yours, but it's understanding the world in which you live and and maybe you don't want. So, for instance, you know, there is some research that, you know, I was very certain to publish because I was working on the way, you know, bacteria use their own virus as a weapon against other bacteria. And I quickly realized that, you know, humans could be doing the same with their viruses and you could be. And so it was, you know, I had to reflect on these sorts of questions. **And I think that adding extra levels of reflexivity on what you do. And so it's not only the science. In its application, but also its implication in developing a reflexivity not only** on Ion, did you learn your lessons of science fact, but did you understand the possible use and misuse of the science and the technology to developing that you should also be considering? And I see that, you know, that's that's. That's key, because I don't know if you know this. It'll be interesting to note in at least university where it's been measure like EPFL, for instance, the Swiss Technology Institute, they measured the level of understanding of ethical questions in their students and compared freshmen to last year's students. And basically, the ethics decrease with numbers of years you spent in an engineering school. Well, OK, so that's worrisome. And the empathy decrease in medical students with numbers of years is going to medical school and the ability to cooperate decrease in numbers the years you spent in the business school. So the currents and that sort of reflexivity about the education process itself. And and so, you know, we live in a world that, you know, select for, you know, qualities that may not be the one that the world needs the most indeed. And so you have to, you know, so it's and that sort of reflexivity at the university level. Yes. And the metacognition and universities do research on many things, but rarely in themselves. And that's something to some extent. That's what you're doing. That's very good. But you're also in the ethics and the value of what the world needs. It's not just can we have a better input output mechanism, but you know, we maximize numbers of students that come out without fail in their test. It's you know what sort of students come out of for school. Are they more

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ethical? Are they more inclusive? Are they able to really understand the complexity of the challenges of the world, not just as exams and in and satisfy the prerequisites that we put in the curriculum? So I think that's the sort of the competent rebels I was mentioning.

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Speaker 1: Great. Thank you. Thank you very much. I mean, the significance of reflection at different dimensions and different levels. I could not have been very well explained by, I think anybody else I don't think. But thank you so much for offering a different level of, yeah, your perception regarding the regarding reflection that is very much helpful for my research as well and for me personally. So thank you once again. And the final, I got one more question in my head while listening to it. So what would be the right stage in the education process itself, from kindergarten to, let's say, PhD or being a researcher? When do you think interdisciplinary should be emphasized more than disciplinary training?

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Speaker 2: I guess. I would say at every age you can do it. And I think it's never too late. But I think that the sooner the more. Embedded in you, it is very often because if it comes very late, it might be more painful to change in because it needs more brain restructuring for some extent in. But I would say that especially in research. And so, you know, sometimes you discover research only at the level you can discover and the undergrad research can discover, you know, as we do with Savanturiers, you can do you can start very young. This sort of learning through research type. But. I think that as soon as **you approach a complex problem. You're going to need interdisciplinarity.** And so if I take. Do you know if the school, as you know, the school that the **LEGO Foundation as has declared to be the best school in the world?** Do you hear me talk about the school?

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Speaker 1: Yes, yes. I think Dr talked, you mentioned it about, I think, **the school in Haiti that you talked about. Yes, I remember**

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Speaker 2: they started at age six, tackling challenge. Savanturiers start at four. So I think there is basically no age limit. And then you can know that, you know, different disciplines will provide you with a different type of tool box. OK. In the same way, you know you have a hammer and a screwdriver and a cell phone, and they are very different type of technology and they help you to do a very different type of things. You know, different disciplines will help you do the different type of scene as well, and different apps on your phone will help you to do different things. And you know, there's things you can do with your hands and things you can do with your body and things you can do with your brain, and they're complementary. And I think that, you know, a kid can understand this very early on that you have difference. There is scenes you can see with your eyes, and since you can hear with your ears and you have different senses and and it's good that you have these different senses because they allow you to enjoy a more diverse perspective on life. You know, if you were blind or were this, you would be losing something again. So if you master only one discipline, then you know you will have your sense, you know, hyper developed in one dimension. But you will be missing a lot of the complexity of the world and the beauty of the world. Indeed. And so I think this you can explain to nearly everyone and you just have to be a little open minded. And it's it's only the people that believe that, you know, their discipline

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is the only important thing in the world that, you know, I think are are problematic for this and and those that, you know, make a living out of, you know, these single disciplines that you know might become problematic.

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Speaker 1: Indeed, I interestingly, I spoke to Leland Hartwell yesterday, and he also gave a similar answer to this question. And yeah, I think interdisciplinary needs to be introduced at a very young level to be able to create that flexibility. And let's see how far I can go with my education at. I'm starting at a bachelor's level, at least to be a bit more younger, but then school is not in my scope at the moment, but hopefully one day I will be able to do so. My interview is almost done. Final question is kind of suggestions or advice that you may have for teachers in interdisciplinary courses. So that might be the kind of advice that you may have that would help students probably to develop such skills. So advices for teachers what they can do one or two things. The most important thing that comes to your mind.

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Speaker 2: I mean, basically a teacher that go interdisciplinary is going to go out of their comfort zone. OK. Because you know, what they know is their discipline is their students starts to do things that you know, they have not done themselves in and start exploring other things, they may not feel comfortable. And so you have to to learn to let go basically, like with a child, you know, when your child walks for the first time in his life or when he wants to cross the first time, the street, we're trying to control the child because you want the child to be safe. That progressively, the child wants to be autonomous, wants to be independent, wants to cross the street, wants to cross the city, wants to cross the world and explore. **And at some point you have to let go. And that's ability to let go is not easy because. People tend to like to control.** And so letting your students surprise you. Is maybe the hardest things, but when you learn to do it. It's also one of the most interesting things because, you know, surprises and being proud of something that you have never imagine is is something that you can, you know, there is a nice French philosopher unfortunately he is dead now, who was sying that the authorities that make others grow. So a mentor is not there to tell you what to do is to is there to help you grow and outgrow even their knowledge and wisdom. And so that's. It's this letting, letting go, I think, is the key. I mentioned that I would mention to someone that has never done it and we want to explore it. And I've seen it quite a lot even with, you know, primary school teachers that go to savanturier or, you know, is accepting, you know, basically. A researcher is an explorer of the unknown teacher very often is someone that, you know, **as explored enough of one domain of knowledge that then they exploit and they want their students to learn to exploit and learning to explore versus exploiting is is a key is a key moment.** And I think that's everyone can understand the difference between exploiting the known and exploring the unknown and and going to another discipline is. There is a difference between what's unknown to you and what's unknown to the world. And within your discipline, if you're a real expert at the discipline, you know the difference between what's known and what's unknown. **When you go to another discipline and into interdisciplinary, complex problems, you don't know what's known and you have to trust your students in exploring and maybe your colleagues that have different expertise, and then you start playing a team game and not just, you know, I'm the little master of my little subdomain of knowledge.** And so you have to know that the

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limits between this and you have to start trusting the others, including trusting the students. And so the only thing you can provide at some point is more this metacognition is this ability to, you know, know. If the group is working well. know, you know, that's you know, there is probably an ethical issue there. No, that you know, there is so many things you don't know, but you know, people that do know and and you can tell them that, you know, this doesn't logically sound because, you know, logic applies across many different disciplines and and so on. So you can you can challenge them, but you cannot control them anymore. And so you have to go from, you know, the eye control you from, you know, and I take you from point A to point B to I let you explore the alphabet and Beyond go to other language and other alphabets And but I can challenge you and I'm there to make sure that, you know, overall, the collective dynamic feels right. And then so you have to start trusting your own gut, feeling much more. And that's that's not easy. But again, I think it's very rewarding when you see your students be able to do things that you never thought of yourself.

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Speaker 1: Indeed. And yeah, as you said, it's not probably that easy for teachers, especially who have already been experienced in a certain way and to be able to suddenly shift the mindset of them. But yeah, I hope in future generation teachers will have that mindset and let

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Speaker 2: you know what's called the Stockholm Syndrome.

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Speaker 1: I've read about it, I'm not entirely sure, suddenly,

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Speaker 2: but the Stockholm Syndrome is someone that was a hostage of terrorists in Stockholm and that eventually married the terrorist that took. And so she fell in love with the kidnapper, the kidnapper. And so basically the the the the Stockholm Syndrome is used as an image that you might end up loving with made you suffer. Mm hmm. And so I think a lot of this is happening in education. And so even if you went through a harsh education from your parents, from your teacher or from whatever, if that's part of, you know, then you know, you are going to see that you have to impose it on others. And so each your own creativity and your own curiosity and your own ability to explore was somewhat restricted by your own education system. Your temptation is to be a strict to your students as your teacher was trying to you. And so that's that's somewhat a harsh moment to to understand it. And and it's not because your teachers or your parents who love you is because they thought that they were themselves victim of that Stockholm Syndrome one generation before. And so, you know, many parents that were beaten kids start to beat their own kids, and it's somewhat the same with with disciplines. And again, it's the same word to that was use of physical disciplines. You know, even physical punishment was to use to discipline unruly kids not so long ago, and it's still happening in many families and in many education systems. And so you have to to start realizing that, you know, for all sort of historical and psychological reason, people are not always doing what's best for them and for the next generation. And and so accepting that, you know, we were in a way victims from previous generations, preconceived ideas on on on what education should be. And so that's why I think being able to listen to not only others, but also to the child themselves or to the

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student themselves and trust them much more and understand that's, you know, cognitive science has shown, for instance, that creativity is peaking in the young age and that, you know, it's OK to become a little less creative, but maybe a little more wise and accept the exploration of the new generation and let them surprise you. You see, it's it's. It's not so easy, but I think it's necessary and.

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Speaker 1: Very true for all of you, are you there? And it's very true, I mean, why I actually came out of our engineering is that I don't want that cycle to repeat. The kind of education that I went through should not be the kind of education what my future generation should go through. That is what the driving factors that kind of changed my trajectory. So I do definitely recognize what the Stockholm Syndrome are the idea represents in education and definitely observed in my own education system. And here most of the times when I come across in traditional universities, etcetera. But yeah, as I said, it's probably a long term goal. And I will try my best to contribute in education as much as I can to change that.

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Speaker 2: And again, you know, if you look at the three idiots and what Rancho did when he created one school and you know what it takes for you to convince the leader of the school that he marries the daughter that you know, there is other ways of doing it. And at the end, you know, you've seen you spend from, you know, space that, whatever. So I think there is all sorts of scenes in that movie that explain very well the psychology of it and and the difficulty and and, you know, who is the idiot, you know, is it the students or is it that the teacher is? It's the the head, the headmaster? Is it the minister? Is it, you know, the school system that is the most? And so I think it's it's a it's a very clever movie to to start a dialogue with these things and and to make them not just, you know, teary or, you know, people that have enough experience, but you know, there is a real world, lots of real world, tensions in these scenes and and humor is always a very good way around complex psychological discussion. And I really think it's. You know, it would be very interesting, especially for Indians, that you, many of them have seen this movie, especially it gets in engineering schools and so on to realize that, you know, there are real alternatives and. And there is also the suicide in this movie, so it's also a very sad movie in many ways, but you know, the humor makes it is you can overcome some of this and the sadness that is there. But. I haven't seen, you know, there is something that I'm trying to see these days, which is to do what I call that, you know, of cour moocs are. You know, I want to do MOODS. And so it's massive online open debate. And so, for instance, I would love to have a massive online open debate on Free Egypt so that everyone that is interesting in engineering education, I think, should see this movie and then start answering all sorts of questions. And so if you want to train, you know, engineering teacher, OK, I see all of them should see the movie and all of them should start thinking about, you know, the Stockholm Syndrome and and so on. And so you could, I think, creates a very interesting teaching program in the research program by showing the movie and inviting people to develop their activity on ways one run. So creative, is it possible? I mean, I I didn't spend much time on Indian Forum, but I did this briefly, and I remember some people say, Oh, that's fiction. It cannot be. And they don't know that, you know, there is a real school like Rancho school up in the Himalayas, and they don't know that, you know, the engineering part was also a Real-Life Stories with a book.

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And you know, they don't know that CRI exists you know, was inspired by this sort of movie, and they don't understand that, you know, there is a real alternative. And so I think there is something to be saved on on creating a massive online open debate on, you know, what engineering is good for and what engineering education is good for and what it was good for in 19 and 20th century. And why should it be different in the 21st century? Because to some extent, you know, engineering is a beautiful way of exploiting the rules of nature and the materials of nature to create manmade structure. But this over exploitation of nature and of its resources is also creating, you know, climate change and lots of ecological destruction. Because, you know, most engineers are thinking only about, you know, they have built their bridge to build and the ethical implications of the long term impacts of their actions on on climate change and destruction. And and even, you know, the fact that they are playing a game as a cog into a big machine that is a capitalist machine that is over exploiting humans and nature. And so they they don't have the critical thinking. And to some extent, the the three idiots is a movie where you know you have the emotions you have. You have that you have to save lives and you have to raise the babies to be born and know there is this really important things that you have to do and you have to be creative to solve the complex problems. And so I really I really enjoyed that movie, and I really think it's it could be a really more than just a metaphor, but a real art teaching the teacher tool. Did. For what? For what? All these things can be, so, you know, it's one thing to to do the theory, but it's another to convince, OK? And I think the movie as as a lot of convincing power because it has a lot of emotional power and has a lot of wit to create a debate in. And especially in India, I think it's a mess, and I'm pretty sure that in Rancho, we like to be interviewed and be proud that you know you're using is human to do that. The research and and the teaching of the next generations of teacher did.

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Speaker 1: Indeed, I mean, this interview has been inspiring as any other meeting that I have had with you, so much ideas and so much things to do. So yeah, as always, and I'm yeah, I'm just spellbound. Yes, but so many thinking stimulations in my head regarding teacher training program obviously connected to interdisciplinary research and everything because my final goal is to actually through the journey of my peers, to become an educational designer and teacher trainer for engineering and other sorts of education as well to be able to impart that knowledge to different teachers and create much more chain reaction in the education system. So I think I could not have gotten better suggestion or vision from elsewhere. Thank you so much for sharing and inspiring. Russell once again, it was an amazing meeting.

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Speaker 2: My great pleasure. Yeah, thank you. Times in question.

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Speaker 1: Thank you. Thank you. Thank you very much. And thank you very much once again for all the beautiful and elaborately genuine answers. It's definitely going to be very useful for my study, and I hopefully will keep you posted in very soon about the findings and insights in the future developments how I actually progressed. Do you have any questions or any comments? If you have, please?

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00:56:48

Speaker 2: Uh, no, not so much, I can tell you what I have on my mind and pick your brain on whether you believe it's interesting or not possible or not. So there are several reasons for this. One is that, you know, I want to increase the impact of the Cree and the other one is that I have to invent a new business model for the Cree because the bit of money that is funding us is running out in three years time. So I have to be creative and invent another alternative. And to some extent, you know, I know that people like you will survive. And so even if the Cree doesn't, it doesn't matter so much because the spirit would be alive in different ways. But what I'm trying to do is skill, which we do. And so I think that some of what we do well is to help students do things together that they cannot do alone and go for complex challenges. And so what I'm wondering is, can we scale this? And so what we are doing is start with, you know, is digital challenges and local challenges that are related to digital challenges have the maybe the local authorities are local ingles, maybe local companies, they find some of those challenges and then invite students to create teams, maybe to tackle their own challenge or one of the challenges that was proposed by the the local community and gets maybe local universities or local mentors to help them. And so you have to find ways to create teams. And so we are using an AI that can help us match students to students, students to mentor students, to challenge students, to project and students to resources that can be physical resources, knowledge, resources or technological resources and so on, and or even financial resources. And then, you know, creates the ability to create teams and then organize local contests of teams that, you know, go for local challenges. And then, you know, as local juries assessing this and giving them, you know, credits from the university and also maybe from some awards and maybe financial rewards and so on. And then at the best of those local teams go to the next level. We can go to the national level and we can go to the international level. And so you build really like, you know, the Olympics for sports, you build the sort of, you know, there is Olympiads for physics and mathematics and chemistry, but there's no Olympics for challenges or for digits. And so I want to build from these local teams sort of a global movement, and the idea is to build the digital infrastructure that can work everywhere. And so you want to start from basically, you know, local bars and global pipeline. And so, you know, the same way the scouts or that or the Sports Olympics, you know, they have ways to help teams, even from very young ones, to become better and better and solving these things. And so basically, what is happening in this Haiti school, you know, you want to create incentive for schools all over the world and universities all over the world to train their students to to be good at challenge and addressing challenge. And that's solving problems that are harder and harder to solve because I think we need you problem solver Evermore, because we have ever more tools and ideas that just basically maybe not all local schools and universities would want to do this if there is actually some global universities that are willing to do this. They can. There is one more scenes that exist in the French law, and I'm starting to discuss this with other universities across the world, including Arizona State University, where the art will is. And that is very progressive and very student centered and very challenged centered. And the idea is to create what's called the validation of the white experience. So the basic idea is imagine an Indian students that is entering this sort of contest and feels that he's learning so much more to be ranch-style than, you know, classical engineering style. And and you know what, if you learn that you know, in, I don't know, 20 or in Arizona, there is a progressive

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university that can recognize when you learn outside of university is as valid as what would be learned inside of university. So some universities can just validate which you've learned elsewhere. And give you the diploma for what you've learned outside of them, but you pass maybe some, some final exams. So instead of taking the wool courses, a four year course for an undergrad or five years for a master in some in a row in the same place, you can start learning something on the way of something in the challenge, something in a team, something hands on something by working in a company, something by, you know, doing a research project here and there, and something by passing an online course and so on. And you can take all these segments and say, OK, I believe this is equivalent to this university diploma. And so the French law is such that the university has to listen to you and history. And so far, it's very bureaucratic process and it's only in French. But what if it was a fluid process and possible in all languages and that it would be in the eye to tell you, Oh, you know, 12 percent, twenty three percent of this diploma, if you were to do this, you can go to 40 percent if you are not 80 percent. You know, if you pass this, you can go to this university and they can study it what you done. And so you basically create a very alternative model where you could learn anywhere, solve problems, where they are, where you are and and get recognized for what you've been doing.

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Speaker 1: But that sounds amazing if we can establish such an ecosystem or a virtual environment that could actually do all of those things, what you said must be. Yeah. The larger digital version of three is what I would say. And because the program that I'm in and at least the Bachelor program, everything that you said actually is being also here, done. But the very small scale the 20 students, 25 students that they are given the opportunity to do electives from second is like completely. But they can take their experience from anywhere from an online course, from a different university. And they this program enables them to give or gives them a certificate at the end of the day by recognizing analyzing it with mentors and advices that they have a degree. If we can achieve that at a larger scale and many students obviously will benefit and will give the ultimate freedom of pursuing what they want and not any more just restricted by the curricula of the institutions. And this would be groundbreaking and yet revolutionizing, obviously if scaled up and successfully established. And yeah, I wish I had that opportunity as well, but I had it through three. But as you said, if we can actually scale it, my first impression for this idea is just mind boggling at my level, to honest, honestly. But there are a lot of practical difficulties as well, as you said, in terms of universities, administrative and bureaucratic processes, so on and so forth. I'm not sure how to overcome all of that, but in terms of connecting challenges, the first idea regarding a SDG and connecting challenges and local challenges, building on top of it, I I'm very much positive about the local challenges, finding local Métis companies and work on the problems. And that is being done as well in many places. But I find it to be a little bit difficult when students need to work on a lot of challenges because then they're immediately losing their relevance with their local context and not anymore. That much motivated are incentivized by the larger picture of the global wealth to help. So to say

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Speaker 2: and that I agree with that I have another call to take. But maybe you can follow up on this, especially if you see that you know your university could be one of the local hubs

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that you want to contribute to the prototype of something like this. Okay. And then it might have different colors and flavors in different contexts. But my hope is that at least one university. Accepts students coming from other universities is if at least one says, Oh, you should've done this elsewhere, I still validate you. Then you know, all the students of the world that want to get recognized for what they do when they go for challenges will go to that university. And I think there is a very good business model for that university that is the first mover because it will attract, you know, some of the most creative students that would want to to get acknowledged for what they do there. And and if you charge for the validation process and not for the courts process and that that's fine. And to some extent, it's what we do in research as researcher, we don't validate what you've done in your lab. We just validate the paper that you published at the end. So we we validate the end process, not the journey. You take two years or 10 years through your papers or two days. We don't care. We just care about you. Did you do something new that is new, at least at your local level, and that is useful at your local level that, you know, I mean, deserve some acknowledgement that at least you're good at fixing the local problem? And then, you know, global problem is a different issue. I agree it's a different scale, but at least some of the global problems are just some of many local problems and not all of them, you know, not all of them are. Divide and conquer type of problems, but at least some of them are. And you know, we could just focus on those and offer great learning opportunities by doing this.

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Speaker 1: Yes, indeed. Indeed. I totally agree, and I definitely will discuss probably this thing with also my faculty and the idea of it because we function in a similar way, but only within the Dutch universities. So when it comes to outside, that's obviously the administration process becomes the most important obstacle for this process.

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Speaker 2: Let's let's we discuss this to go. Yes. And maybe we can even go for, you know, some European funding at some point for this.

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Speaker 1: Yes, that would be great. Thank you so much once again for so and it was a lovely conversation. Once again, thank you so much for.