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00:00:00
Speaker 1: Great. So could you briefly introduce yourself?

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Speaker 2: Well, yes, my name isx . I'm an assistant professor at Mesoscale Chemical Systems. I speak Spanish. So English is my second language and I currently teach at chemical technology.

00:00:29
Speaker 1: So what kind of courses do you teach in in the Department of Chemical Technology?

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Speaker 2: Um, well, currently I'm teaching two topics one on them let's say, bachelor level on one of them is Masters. So, um. As for, the Bachelor is called electrochemistry and as for the Masters it is an elective or up to two? Um, that actually is called PCA that stands for process chemical analysis.

00:01:07
Speaker 1: Thank you. So my interview is all about higher order thinking skills. And before I ask you that question of definition, I would like to explain a little bit to clarify what does it mean? Higher order thinking skills has nothing to do with the content knowledge. So the lower order the thinking skills, so to say you could see the ability to memorize and remember and recollect facts and knowledge basically, and the ability to analyze, evaluate and implement it in different context is what majorly considered the higher order abilities not only just remembered, but use that information in a way that is critically analyse it to find patterns among different things that there are different things about it in the context of your course. When I ask you, what does higher order thinking skills mean? Given the definition, I gave you an explanation. What would be your perception of definition? higher order thinking skills in the context of the course, right?

00:02:10
Speaker 2: So in the context of my course? I will put it more towards students. I think that's the key element here. So ideally, what I try to do is to habilitate all available tools to students basically during the learning process. However, one important important factor that I do to apply in the course, and I think it's pretty much related to your question, it is something that they call connecting the dots. So basically what I do to. Basically between Sessions is like I try to kind of familiarize the students that each topic is not isolated from each other that are interdependent or could be intertwined. And those. Topics should be combined at some point. To create a tool kit tool kit to solve a specific problems that's actually kind of the way it I will, you know, kind of understand based on what you are telling me.

00:03:21
Speaker 1: OK, so if I understand correctly, it's about connecting dots and using the right tools to solve a particular problem. Particular problem? Yeah. Do you have a specific ways of solving a problem? This is just very general.

00:03:39
Speaker 2: But since we are actually, uh, giving the topic of chemistry, everything to we are

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on the night to chemistry. I mean, I cannot, you know, come with something else wrong? Let's say colloids or something like that. I mean, it's possible, of course, but it's very much too restrictive to, you know, more particular actions or targets for the students.

00:04:10
Speaker 1: So. In your part, so I just reformulated what you said to basically understand better higher order thinking skills means the ability to solve problems in the context of your courses but it has different processes. I think the goal is to solve the problem.

00:04:25
Speaker 2: Uh, the goal is to solve a problem. But of course, high order thinking involves, you know, learning of concepts. By definition, try to basically find correlations between each concept all together applied to solve a specific problem. So it's not isolated household isolation what I don't expect to have isolation between, you know, each concept. I don't know where there should be sequential. Otherwise it will not have any meaning.

00:04:59
Speaker 1: Indeed. And do you then explicitly teach them, apart from the content concepts and knowledge in terms of problem solving and ability to find connections and etc., etc.? Do you teach them explicitly in your course?

00:05:14
Speaker 2: Yes, actually, we use a very interesting approach, applied actually this year, which is called conceptual modelling, which you are also familiar with. I'm pretty sure because this is a way of activating knowledge and not being basically restricted by what a book sets, you know, is not that restrictive. Of course, you can always check the book, but there is no limitation. We try to go beyond that.

00:05:48
Speaker 1: Indeed. Could you elaborate conceptual modeling? Briefly, what does it mean, how to implement it?

00:05:55
Speaker 2: Well, the way that we implement conceptual modeling in the in the course is basically that we provide to the student in particular task, for example, it could be in the laboratory. So, uh, as for the laboratory, sometimes we will provide, you know, you have these tools available, so. try to basically to formulate your. Your model? Try to evaluate the different parameters that you could measure with the tools that are being offered, but we don't say anything. We just just leave them, you know, it's up to them. As for that, we we meet the students. We start asking questions to ask more, you know? That's kind of the kind of questions that are feasible based on the tools provided, so by means that the learning assistance or the learning process is being guided. Because if we leave it, you know, too broad, that will be spread and then there will be lost. So we try to, you know, go with the learning process to guide them into a specific questions, but they don't know. Yeah, OK. Right? We never say. What the specific question has to be is, you know, we just leave them to formulate them themselves. Then there is a second step which is basically putting in practice what they have developed into the lab. So first, they construct the first model. Hmm. Just everything is theoretical planning question, et cetera hypotheses. I don't like to say a hypothesis any longer. I like to say, I like to say research questions or questions right

then. OK. After the questions that they want to solve because they have been plan on paper, then they go into the lab and they actually perform experiments by themselves. Then they are taken out of the lab and then we have a second meeting. Again, you know, the learning process meeting in which way we discuss observations based on experimentations, potential or a data analysis by utilizing mathematical methods. But we never sat with mathematical matters how to utilize. Of course, they have to select from the already prior knowledge, from any other courses that they have already been taken at the university level or the, I don't know, high school level whatsoever. And then we try to, you know, help them and guide them a little bit further in order to allow them to answer their specific questions. Because we are we are not giving questions to them. They have to come with the questions themselves. That's actually part of the second, you know, part of the modelling. And then we come into this. Last part of the modelling, which is basically the generation of a report, were all things that are being thought were analysed whatsoever are placed in the report, and then the students have to be able to kind of, you know, differentiate the last from the beginning, so by means of I tried to force a comparison of the thoughts before the experiment and after experiment, and I tried them to analyze what was the thinking process because I think that the way that in the future, if they will like, for instance, the researchers or be working on research and development in a company whatsoever, does the thinking process that they have to come along with because at the end they will have not any help. So they have to take their own know way of thinking, develop their own tool of the toolkit of knowledge sort of thing.

00:10:26
Speaker 1: Fantastic. Thank you very much for sharing. That was very nice. Really interesting as well. I just would like to know before that. Do you do this at the master's level or The Bachelor?

00:10:36
Speaker 2: This is a much, much more bachelor's level.

00:10:38
Speaker 1: OK. And so when you say a way of thinking, obviously problem-solving has a way of thinking, do you have anything specific in mind that when you mention, when you see a way of thinking for process for students, what do you exactly mean by ways of thinking?

00:10:58
Speaker 2: Well, basically that the students have the whole freedom to ask for the questions as they will be like or they will like to. Because, you know, to solve, for instance, for instance, an equation. You might take one route and I might take something else. Yeah, I don't care at the end as long as you give me answer, as long as there is logic. You know, conceptually all knowledge being applied correctly .

00:11:28
Speaker 1: So you just put some restrictions that needs to be outcome. And then there is a process in which are questions and logic and coherence plays a role in formulating it. And what do you do? at masters level do you do similar things?

00:11:45
Speaker 2: Not at the master level. I do it a little bit different because actually

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00:11:51
Speaker 2: to 2021 was a year for me to get in contact with conceptual modelling on the master level. I've been teaching for a little bit longer, so I couldn't. I was not given the opportunity to apply it to the Masters. But perhaps next next year might come around. At the master levels what I do. Basically, I try to. First of all, teach the different, different topics that a student needs to convey within the course, which is basically for you just to give you a brief explanation, it's all about statistics. I think you or also so or you might be also familiarized with the concept with design of experiments. concepts like, you know? What I would call it just basically design for experiments, and there are multiple ways of, you know, or methodology that you could apply for X or Y process because at the end well, I do to I pick up processes from industry and then. They are, for instance, design of experiment that they call Factorial. Then I take that data from the, example from the industry. And then I start teaching them how to apply, for instance, factorials into it or fraction factorials or Taguchi or, you know, all of these sophisticated statistical methodologies that they call that could be very useful for them in the future. I apply them. It's a little bit old fashioned teaching. I will say, but well, for the very first time this year, what I did ask them for us in previous years, I brought people from industry working at different companies and they gave in total were three of them. And they gave three different workshops where, you know, they provided an example as well. Apply example from their companies. Um, where actually these statistical methods could be fitted,looking and how useful helping that having this kind of, you know, tools for them in the career whatsoever. But as you could tell, a little bit different than bachelor.

00:14:35
Speaker 1: Yeah, indeed. But still, I think it sounds very for me, very interesting and useful. It must be student must be gaining a lot of knowledge. And so when it comes to the process about the content, as we are discussing, that is the subject of the conversation. How do you assess if a student had reached or acquired the necessary process in their thinking ways?

00:15:04
Speaker 2: the way I assess the bachlelor level, because there are two different ways of assessment in this particular case. I do it basically by looking at, uh, uh, this year, I did it basically by looking at reports and lab journals. However. I kind of discovered that I totally disliked that, so I rather for next year, I would like them to actually to come with a presentation because then I really clearly see if they really, really get into the concept themself. Because it's different to write and to copy paste from the internet than what you tried to explain to an audience. What were your findings and how you sovlve them? And that's where the next year, actually that I will do. And um. Is easier, you know, knowledge will be reflected if they understand the concept, it will be reflected immediately. As for the Masters, everything was based on assignments. A final report. As for the it's a little bit more complicated, to be honest, because their way of assessment is for them. They are kind of in a high level already, so I'm assuming that that the master point that they should already, you know, acquire this kind of development tools as a conceptual modeling. It is perhaps not, perhaps I'm mistaken, but that's something that I have to ponder and evaluatefor the next year.

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00:16:55
Speaker 1: Indeed. So when you went to report and then also in the upcoming days, you are planning to implement presentation as a one of the assessment criteria. Obviously, content knowledge will be reflected, but also process knowledge, the ability to solve problem. Do you have anything in mind to, for example, test their ability if they could solve the problem? Or is it just because through assignments that you already?

00:17:23
Speaker 2: No Well, uh. As for that, I mean, they have already to with in the same presentation, they already have to show how to solve the problem. The process that they're bringing to it, the mathematical formulas, physical meanings, they have to be already embedded. It's not like, you know, we'll give a presentation about why this sky is blue. No, it's not like that. So basically, it's going to be a presentation very much focused to their own results and how they are able to interpret it, that part of the interpretation already it includes the problem solving in it.

00:18:02
Speaker 1: Yeah. And so given let's say in your class, you have 30 to 40 students at one hundred students, depending on the race. Do you say that all of your students reach the same level as you expect in terms of higher order thinking abilities?

00:18:23
Speaker 2: No. Do you know? Each each person is different, therefore they have different ways of processing information. And therefore, I do not expect to reach also, at least for them, all the same level. You have very clever students that will reach out immediately, and they will they will not have any no problems. I may have also students that you know, they go slightly learning along the way. So and they're reaching original, very advanced knowledge et the end. And we have, you know, very flustered issues that, you know, sometimes you cannot activate them, even though if you do your best. Yeah. But of course, I always try to, you know, activate them and to reach the best outcome at the end of the day.

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Speaker 1: Indeed, you possibly mentioned as well know people process differently. Each individual is different. What are the difficulties and difficulties for students in the context of coursee you believe that limits their progress?

00:19:50
Speaker 2: I think I think that I think it is a topic in itself because if they have a tendency to find it difficult, electrochemistry for them is a little bit complicated because chemistry, OK, they are able to, you know, to handle to tame old concepts. However, when you put electro, they still difficulties, you know, to to get it right. Um. Yeah, I think. The conceptualization of electrochemistry itself, also the process or electrochemical reactions are slightly different to what they've seen so far. At the point in time where it. Yeah. So there is always, you know, a barrier at the beginning with them. To basically to. To grasp and to really understand what is electrochemistry about.

00:21:00
Speaker 1: You mentioned that chemistry is not a problem, but then when the moment Electro is introduced, it becomes a little complicated. Why do you think it's is the case

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Speaker 2: because they've never been confronted with? I would call it electricity themself, because I cannot, as you know, of course, thermodynamics kinetics. It's always the same. That will not change by the point. But when they start, you know, thinking about that one and electron could be floating, with in the solution. I put a very minor here and that electron allows conductance and that electrons go hop into a molecule to induce chemical transformation. Then the story gets very complicated.

00:21:51
Speaker 1: OK, great. Is it because I just would like to understand better your view? Is it because just that they haven't learned it before?

00:22:02
Speaker 2: This is the first time that they been confronted with that electoral terms?

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Speaker 1: Yeah. And also, do you think because it's hard to make assumptions? Is it because also of the abstract of those concepts that you are not able to perceive electrons jumping from one molecule to other molecule inducing chemical changes.

00:22:22
Speaker 2: I think, is not the attractiveness of the concept itself. I think everything boils down to association of in terms of knowledge. Because as I said, you know, thermodynamics will never change and kinetics will never change. So basically, everything should ideally. Well, no, never change in terms of knowledge and. I think what everything was. Well, everything boils down boils down to. To a different way of thinking, but still, you know, get very scared when the election comes around because they are kind of freaking out. If I'm allowed to use that as an expression because they start thinking, OK, these electro so all the thermodynamics are different and all of this stuff or, you know, are rather complicated. So. But you know, the point here is. Along the way, they realize that it is not the case because they start feeling more comfortable. Yeah, some of them get very nervous. But when they realize, you know that this is no more than what they've been taught in the past, the only thing that they have to do is to add electrons and to calculate potentials based on thermodynamics. Then they just get, you know, little bit more relax, however, by saying that I think, there is a lack, but in the teaching program, and this, in my own opinion, where. Chemical equilibria is giving at the same time, as Electrochemistry. But in order for them to really get more into electrochemistry, electric chemical equilibrium has to come first because chemical equilibria involve all reactions. Rather, reactions and reactions are very important for electric electrochemistry, and you cannot at the same time, give abstraction to students when they are facing electric chemistry because they know they will not have time enough to absorb the knowledge and to apply the knowledge into Electric Part. So I think that's one of the main complication, but meanwhile, we have to live less us, you know, how it is.

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Speaker 1: I hope that can be implemented. That changed upcoming curriculum design.

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Speaker 2: I hope so. But this is a kind of a new curriculum. So it's like, OK. But in any case,

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I'm not the one making the curriculum. You're making the decision in this particular case. What I could says is basically this is a clear, clear example that they need a high order of in terms of the knowledge based on how to apply it into practice.

00:25:30
Speaker 1: So my next question would be on about teachers. What kind of challenges in the context of your course that teachers would face in helping students acquire higher order abilities? And what can help?

00:25:48
Speaker 2: Hmm. I think I think its students need definitely time. One of the limitations and having, you know, a group of 60 students sometimes a single Teacher cannot be divided into 60 different pieces and therefore what we have done this year, we have learning assistants. So but still in total, we were five persons tried to cope with 60 students. Fifty, I will not exaggerate what they were a of sixty, but at the end they subrtracted. But OK, so this is a good number and. And I think something that is not very much appreciate it is at this point. Is the activation of knowledge? By means of activating and students generate and generate the interest, and therefore when there is interest. You could basically do whatever you want, you know? Yeah, but sometimes there's a lack of, you know, motivation or interest, and I think to cross over that barrier with students, sometimes it's a little bit more challenging. But, you know. At the end of the day, I managed to it. I thought I found myself, you know, a way of of doing this.

00:27:36
Speaker 1: Thank you. I think that covers my. Yeah. The concept of high order thinking, skills and incentives. My second section, which is a very small section, is about interdisciplinary approaches in science. Obviously, electrochemistry by nature, really interdisciplinary. How do you define interdisciplinary research?

00:27:56
Speaker 2: interdisciplinary research is basically to utilize different, um, building blocks by means of, you know. Electro chemistry, natural sciences whatsoever. All together, conceptually, Merge, to understand a specific question.

00:28:23
Speaker 1: Understand a specific question by combining differenttopic, different disciplines and this. So for that, given that definition, what would that, what would be the first thing that comes to your mind as a higher order thinking skills? That is important to be able to do this process.

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Speaker 2: I need you please repeat the question again, I said.

00:28:48
Speaker 1: So you said you gave a definition of interdisciplinary research in view of that definition. Mm-Hmm. What is the most important skill that is needed? To be able to do that. for a scientist, for a student.

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00:29:04
Speaker 2: To be open. yeah, mentally open because. Yeah, we yeah, that's that's the effective ,the key parameter for I would say.

00:29:20
Speaker 1: What do you think? What do you make, what makes you think that people are not inherently open?

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Speaker 2: Because they're very much confined into their own topics and on top without exploring, you know, what is beyond?

00:29:34
Speaker 1: What could help to make them open in that case to me?

00:29:38
Speaker 2: Yeah, yeah. To strive for for their own interest because as I said already. When there is interest, you could learn whatever you want. So in my case, you know, I know that I'm not very good with programming. This is an example, but is because I don't want to spend time and I don't want to invest time. But if there were there, there might be something that drives my my interest and I need to go through programming, then I know that I will spend two to three weeks until I just, you know finish.

00:30:24
Speaker 1: , yes. So for you interest is the major or motivation, for that matter,

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Speaker 2: Yeah its motivation, well, interest if there is interest there is motivation. And if there is no motivation, there's no interest in this.

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Speaker 1: So, for example, let's say I'm very much interested and motivated, and I would like to learn, but I am a more traditionally trained student,

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Speaker 2: then I have you too take the right part. No problem. Yeah.

00:30:58
Speaker 1: So you believe that if I had that enough emotion, motivation and interest, I would find my way.

00:31:03
Speaker 2: Of course, that's the role of the teacher. And yeah, that's the reason that we are paid for it. Yeah.

00:31:09
Speaker 1: So. As a teacher, what is the crucial role in having a potential student who is competent and motivated, then you want him to go reach the goal? What is the one thing as a teacher that you are probably a teaching philosophy, for that matter, is? Yeah, helps would help the student. I mean, what is your teaching philosophy in that context?

00:31:35
Speaker 2: Yeah, my my teaching philosophy is that. You should never. Stop them, and you

should always push them and. Without them to noticing, guide them to walk towards the final. And, Reach goal.

00:32:03
Speaker 1: I think it sounds very simple and easy to listen. And I think I know how hard it is actually to do all of this.

00:32:09
Speaker 2: It is challenging sometimes.

00:32:12
Speaker 1: Indeed. So yeah, I think I'm done with most of the questions. Just final question if you have any tips and suggestions and when it comes to developing order abilities and students, as a teacher, as a researcher, what would they be?

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Speaker 2: I think, uh, first of all, to me, as a teacher should be more confident and comfortable. with these. They are this kind of way of thinking that, you know, it is, you know, that is lacking at the university level. And I started already myself with this conceptual modeling stuff, which I very much appreciate at this point. But at the same time, you know, the key point here is to make researchers and teachers to realize that due to these concepts do exist. And to try to as the students, because as teachers, we also learn our students try to reinforce these concepts by make, making them to be aware that they exist, even though perhaps they already not applied them into the practice, but they don't realize that they are doing it already. And so, for instance, concept of mulling as a researcher, I was already doing that, but I never realized that I was doing such a thing until, you know, someone gave me the right and correct correct name.

00:33:54
Speaker 1: That's interesting. I'm sorry for that, I'm just that gave me a bit of a question, so you just said that you practice it, but you just don't know what it is. Yes, right? And you were not able to actively probably reflect on it. Yeah. So in that case, what could help in? Yeah, kind of making people aware of such things like

00:34:17
Speaker 2: I think one of the ways that that worked for me was to get in contact with, uh, with peers for instance, meike, once during one of the discussions, she says, OK, you know, I have a very interesting way of thinking that could be very useful or applied in chemical technology. Uh, would you be interested to explore and explanations The explanation of her actually motivated me and was more interested was there? And therefore, I thought, OK, let's try. Let's try to, you know, shape the whole new program because this program needs to be built from scratch. Well, I apply to it, of course, with her help because alone. Having to apply that concept, I will not be self-sufficient. Because I wasn't familiar with, but now I'm much more confiden as I was before.

00:35:28
Speaker 1: Yes. Thank you. And finally, final question, I just said, that's the final question for the last question. So do you know, are you familiar with the term called metacognition?

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00:35:41
Speaker 2: No.

00:35:43
Speaker 1: So metacognition is the ability to reflect on your own thinking processes, OK, I'm just going to mention this just struck me that. And if that were to be developed as a skill, what would be your view on it? Or do you think will be relevant, significant?

00:35:58
Speaker 2: I think that definitely is significant because, If you want if you if you want to learn. You need to always reflect back to what you have done. Regardless, you know, research even in life. Yes. So and that's human process. Yes. So it's a natural process. Yes. So it will come automatically. So it's always important to reinforce self-analysis and try to fine tune yourself towards new incomes.

00:36:32
Speaker 1: And do you believe that at the university setting? Is it being explicitly?

00:36:36
Speaker 2: No,

00:36:38
Speaker 1: OK, thank you. Thank you. Thank you. I think that covers my interview sessions. And thank you very much for answering patiently all of my questions, particularly when I said last question, but it was very interesting. I got a lot of I got a lot of insects actually, especially from your responses. I got new questions and then I formulated it, and it was very nice for me to have that insight. So thank you so much for giving a tour in your teaching world and also in to your research world. That was very interesting.

00:37:08
Speaker 2: I hope that I explain in the best possible way, but if something is not clear, just let me know. Yeah, sure, I do that.

00:37:14
Speaker 1: Thank you. Hopefully.