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00:00:03
Speaker 1: Do you need any clarification?

00:00:04
Speaker 2: No. The questions will come, I think.

00:00:09
Speaker 1: Yes. OK, then let me just get the questions right here. Can. Yes. So the first question is, as my title suggests, it's more about higher order thinking skills, I would like to know what is your view or idea about higher thinking skills? How would you define it?

00:00:50
Speaker 2: Yeah. You start with the most difficult question. I'm I'm not sure if I think in concrete examples, then need to think of critical thinking, contextualizing knowledge, creative thinking or integrating different disciplines. But these are kind of come to mind when thinking about higher order thinking skills. But I'm not sure actually what our lower order thinking skills is. That something only when you react? On the basis of intuition or so. So I'm not sure whether you can really think higher or lower order, maybe everything that we are doing or a logical reasoning trying to make sense. It makes sense to others communicating. Are also quite complicated, and so I'm not sure where you are in your research, whether there is a specific focus on specific points of higher orders skills or that you have you have a set of criterion.

00:02:00
Speaker 1: So, yes, indeed, it is very general. The thinking skills in my research, I try to find some relevant knowledge and literature that has been studied and published in a specific focus concerning higher order thinking skills. Before I give you that are what I do in terms of my research. Would you have any theoretical framework that you refer back to in terms of higher order thinking skills? Or is it just a general notion that you have it based on experience?

00:02:34
Speaker 2: Yeah. Yes, based on experience. But I've also done some work on creativity, creative thinking and now in the comenius project with miles and we are working on interdisciplinary work. So that's also something that I'm.

00:02:55
Speaker 1: Yes. So in terms of Lowere and higher order thinking skills. One of the basic are most widely known framework is Bloom's taxonomy, in which based on high cognitive functions, ability to analyze, create and synthesize are considered usually some form of higher thinking skills where as the ability to remember and then recollect and yeah, such understand are considered in the hierarchy of taxonomy. Lower order so evaluation.

00:03:29
Speaker 2: So you're more interested in, let's say, design skills, the synthesis skills and evaluation analysis?

00:03:37
Speaker 1: Yeah. Yes. So if you actually look at some logical reasoning, point of view of all the skills that you mentioned imply one or the other way some form of analysis and synthesis, inferences, predictions, so on and so forth. And so that is why I wanted to know if you have

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any specific framework as a foundation that you believe in. Ah, yeah, it is all similiar, but I would like I wanted to know if you had something in mind. That's it. So that actually gives me a lot of already a good start. I thank you for that. So the second question would be in your own course that you teach, do you explicitly teach such high order the thinking skills? If yes, how do you kind of integrated with your content? Hmm.

00:04:29

Speaker 2: Yeah, it depends a little bit, which of course I take. Maybe if I take the master course I do with business administration, management and governance of innovation and creativity that we pay attention to the critical analysis of literature in which students have to read certain articles, write a review on that and then we have a discussion on that and discussion in class. I also try to. The two stage confrontations to have real discussions that would see students who have differences in opinion, but also let them look at literature for more meta perspective rather than focusing only. What's the conclusion, what comes out of it? Also seeing it as something that the author comes up with right writers to also ask this question who does he confront his ideas with or or what does he build don so to make them also more clear how articles are being created? And also that they have to write their own paper and show indeed that they can have a critical stance towards academic, let's go beyond simply. So I think these are higher order thinking skills. So it's critical analysis plus. Kind of design of a paper in this synthesis paper and yeah, by having discussions, asking critical questions and giving specific assignments, review assignments and. Repeatedly different teachers are doing different discussions with students. We hope that they develop such high order skills. which you may apply later on in master studies when they write a thesis.

00:06:40

Speaker 1: Nice. Yes, it is very clear that, yeah, it's a kind of a combination that you created the whole are designed in a way that it kind of supports the development of such skills very regularly. Yeah, at a regular interval. Do you have assessment techniques that gives you an insight as to how much a student has developed this kind of skill? Quantitatively are objectively or even subjectively. Do you have a criteria and binders that enable you to understand?

00:07:21

Speaker 2: this specific case? You we assess the product. So the paper did come within you and then also the reviews. And then you look for indications of critical thinking or original thoughts or that you say, well, this argumentation makes sense. I also value the oral exam a lot, because an oral exam, you can really have a level high level discussion with with students and then you can really see whether they are. If you come up with a nasty or unsuspected question, can it come up with an answer that makes it so it's not objective its not quantitative, but by either looking for what is original, what is the well-argued? What is what is their thinking or going for that in a talk with the students? you get an idea How well did they mastered?

00:08:24

Speaker 1: Nice. It is indeed up from my own experience as well, I can understand by having actually oral discussions, we could definitely see the level when the student actually talks about it passionately with the critical point of view. But we can actually subjectively assess

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the student. But is there a way that you think I'm just asking you out of curiosity? Can we formulate something that would objectively indicate as while having such discussions, for example, from our end, not from really from Student's point of view, when we interact with them, can we formulate a clear criteria that could enable us to quantitatively decide the student has actually reached beyond the expectation?

00:09:17

Speaker 2: Yeah, we do it in a way in which do the ATLAS project assessments and also in this case, so then. Then it helps that you with more assessors. But you think, well, this makes more sense than the other, so it's not so it's possible to quantify, but to make an algorithm out of it. That's a little bit difficult, especially because what's critical thinking and the thing is with creativity, there's a lot of literature on how to assess creativity. It's always problematic because creativity is about going what is and what is not expected. You've come up with things that are not are novel or that might be useful, and it's always true for someone to to judge whether something is novel. And of course, if you have someone who has a lot of experience in the field, the easier to assess whether something is new or not, if you know, nothing and everything is new. then its can be difficult to to judge, but it's still hard to to objectify. For instance, if you think

00:10:34
Speaker 1: yeah continue sorry

00:10:36
Speaker 2: Yes. Also in different courses, if you're doing product development, you come up with new product and judges people will say, Well, I'm new with this, but it's hard. It's not. It's not easy to predict whether it will be a success in a market where the novelty will be appreciated. So there might be quite some discussion about it. So having more assessors there? Kind of safeguard that you're not. Purely subjective in your assessment of novelty.

00:11:17
Speaker 1: Yes. I get that. No. Thank you. Thank you very much for sharing your insight regarding this. My next question would be regarding challenges for teachers. What do you think is the challenge or what are the challenges faced by teachers when teaching such higher order thinking skills, such as creativity or critical thinking?

00:11:40
Speaker 2: Some teachers, it's challenging to just shut up. So stop, stop telling students and explaining things, let them do things and experience things, then try to coach them and to guide them. So teachers have a rule, but they need a kind of a different role than with the lower levels of taxanomy, and you can just tell them, show them.

00:12:08
Speaker 1: Indeed. I can totally relate. Yeah, teachers, it's really hard when students are not able to do it and immediately step in and guide them it. And from your experience, what are the challenges faced by students when acquiring such skills? And you might have come across a few students who would not? Yeah, you couldn't actually acquire assets skills. What do you think are the difficulties?

00:12:34
Speaker 2: You know? Yeah. For instance, when it comes to this critical thinking, then it's

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sometimes for students who come from universities of applied sciences and to the master. They're not used to questioning literature or data. They only make summaries and then try to apply. So they need an extra coaching very specific on their writing or asking the specific questions to. And to help them to get to this critical point, then it helps illustrate discussions with others to see how others look at this literature. But it takes a while for them to make the penny drop. And when it comes to other skills, for instance, creativity, then there are so many exercises, for instance, that you can use that also helps to create some confidence with students to think out of the box. So if you were brainstorming brain writing or synatics or whatever technique you use that that may help.

00:13:53

Speaker 1: Indeed. So, yeah. The difference in disciplines could be one of the reasons for some students for not able to reach the level unexpected level. And your suggestion is also would be to have some exercises planned, especially for creativity, which probably if I understand correctly, you believe can be developed through such intensive or regular exercises that work, practice.

00:14:21

Speaker 2: Yeah, it could be a good start. And also giving you confidence that its creativity is also daring to think out of the box. So I think if you have a group with different disciplines, different backgrounds, that helps to. To be creative just because you are different and that you can interpret each other's concepts and views differently. So for this, it's also the informal process facilitating that, but that helps.

00:14:52

Speaker 1: Mm hmm. Thank you. So my my next question is, again, going back to the first question. So after having discussed all of this, would you be able to now formulate an overarching definition of informal definition about? Yeah. Higher order thinking skills in the context of the course that you teach normally. And so a general one objective of higher order ability, would you? What would you? Yeah, how would you formulat it?

00:15:24

Speaker 2: for this specific course? It could be, let's say, the critical creative. Analysis and synthesis of theories in the field of innovation management, and so they have to have another way of critical the critical thinking about the contributions that the others and then creatively developing their own thoughts and bringing that together in an argument.

00:15:58

Speaker 1: Indeed, great, sounds fantastic. Thank you, thank you very much. I think I would like to, yeah, probably take that course once. It sounds really stimulating intellectually to, yeah, go back to such courses.

00:16:12

Speaker 2: Yeah. But also it is in ATLAS in IBS, we do things like that in the club reading system. So that comes close.

00:16:19

Speaker 1: Nice. I didn't know that, actually. That's good to know. So yeah, I'm I'm actually completed with the higher order thinking skills section. And the second section would be on interdisciplinary research. So again, I would like to know what is your view and definition

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along with that of interdisciplinary practice or interdisciplinary research in engineering education? And yes, and it's important.

00:16:50

Speaker 2: Yeah. So inter-disciplinary would be if you compare it to, let's say, transdisciplinary and multidisciplinary. And I think that interdisciplinary work or interdisciplinary thinking really brings different academic disciplines together and create something new. There is a learning from one discipline to another. It may be that new concepts arise from the intersection different than with multidisciplinary, where you can do the decomposition of the problem long academic disciplinary lines in an interdisciplinarity. There is this disintegration of cross-disciplinary team. Is that also different modes of knowledge that are non-academic play a role has the knowledge that is with citizens, with practitioners, stakeholders, which also makes that the combinations that arise in transdisciplinary working are much more dynamic. They're different every time that there are different stakeholders around the table. While nterdisciplinary can also be stable if you have always the same kind of people working together on a problem. Yeah, they they actually become a new discipline like mechatronics or there. What is it if you have biology and medicine and medical biology? So it's also the new interdisciplinary fields can develop a new disciplines while always practice Banerjee. There's much more dynamism in the.

00:18:46

Speaker 1: So that was very kind of a short course for me, very succint and brief about my transdisciplinary and interdisciplinary definitions and distinctions, especially how do you think in terms of engineering education, which is more suitable? or, what is the prominence of interdisciplinary research in engineering education? Yeah, both are, I would say, important. But at this moment, which one is more prominent? And how do you perceive it? your personal view on it?

00:19:19

Speaker 2: Well, I'm I'm biased, but I think that interdisciplinarity is really very important for engineers, but also for social scientists, even more, maybe at the UT to combine it. So what I find most intriguing is if you really want to integrate perspective from social science, humanities and engineering, of course, that is much more often. Eye opener for students and there is much more added value, you then when, for instance, a mechanical engineer and an electrical engineer would collaborate because they're kind of likewise, at least in cognitive approaches in local culture? Maybe differences say they may have all kinds of stereotypes of each other, so the social aspects of interdisciplinarity are very important. When you you, you collaborate. Cognitively, it's easier, but when you start working with with social scientists then and then really interesting things go, go on. All right. For instance, with the master inCert where we had two psychologists working with computer scientists, they have. They they have difficulties in understanding each other's approach, you would have qualities first wants to analyze everything to the depth, computer scientists just wants in an agile way, try try things out and then see how things work. So more of prototyping approach. So in these these really interdisciplinary project, it's they learn a lot because they are quite far away in their approach of problems. The knowledge that they bring in, the reference that they have.

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00:21:18

Speaker 1: I you got a little bit stuck in the last two, three seconds, so I just wanted to, but I heard in kind of a slow motion. I just wanted to know if you hear me correctly.

00:21:30

Speaker 2: Kind of. Yeah, you're a little bit shocking, but

00:21:34

Speaker 1: then I'll switch on.

00:21:36

Speaker 2: No, it's just my video. It's OK. I can just, you know, if sure I can, I can see it's OK.

00:21:43

Speaker 1: OK, good. OK, thank you. Um, so thank you very much. Yeah, indeed, I totally can understand. I also very much biased as a researcher in terms of interdisciplinary research, and that is something that I have to deal with in the further analysis steps. Yeah.

00:22:00

Speaker 2: Because it's so different. So education, engineering, education, it should be into this for research. It has other kinds of issues, for instance, to publishing about interdisciplinary research, the more difficult and more disciplinary oriented research and for practice with students that different.

00:22:19

Speaker 1: Yes, indeed, indeed. Very much. Um, so my next question would be again, skills in terms of interdisciplinary research or practices. What kind of higher thinking skills do you think are more important? Um yeah. If you think there are few you can list and then I would follow up with some questions.

00:22:48

Speaker 2: So what I think are the most important interdisciplinary skills that they?

00:22:54

Speaker 1: Yeah. So as a student, what, for example, should develop in order to efficiently carry out interdisciplinary research practices or academic interdisciplinary academic practices? Yeah.

00:23:08

Speaker 2: Referred me to the social skills. The teamwork. Collaborating with people, peoples, other cognitive strengths. Communication skills and open communication, openness to each other. Willingness to learn from from each other. And then there are, you could say, both conceptually and methodically. Skills that are important, for instance, design thinking could be or another more challenge based approaches on a kind of more generic system thinking. It's also something like concepts like social technical systems. So some understanding of these methods and approaches that are overarching and can be applied to to to these kinds of projects are also important. And then you could say also the metacognitive skills that at some point you can see your own discipline in context. You see the limitations of what you can do.

00:24:19

Speaker 1: Nice. And yeah, you gladly touched upon my next question, which is

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metacognition. And as you touched on it, I assume that you have some understanding of about metacognition. And so my question is what is your how important it is in interdisciplinary legacy for higher order academic skills? The role of metacognition in higher education.

00:24:51

Speaker 2: I think it it is important it may be not the first thing that you have to learn when you do. On the other hand. Yeah, I think so depends a little bit, but what my performance, what you said, what if you indeed have a better understanding of your own discipline relates to others? to see the differences, at some point, seeing also that you need others. I think that is of added value because you can be more productive in this interdisciplinary teams. I'm not sure exactly about the timing and the master Incert we could say, then we actually start with this. So we talk with students about world views, they make metaphors so they start with stuff to get around, but they actually need to do an interdisciplinary project and reflect on it to see what it really means. To really understand.

00:25:55
Speaker 1: You know, yeah,

00:25:57
Speaker 2: it's good to really be able to contextualize your experience, so it's. Something that happens at different, different moments.

00:26:07
Speaker 1: Mm hmm. I totally agree. So would you say then, for interdisciplinary research, the role of metacognition is quite prominent because it, excuse me if I differently formulated differently. The role of metacognition in interdisciplinary research is important because it enables one's own understanding of the disciplines.

00:26:33
Speaker 2: Yeah, and it makes it easier to collaborate with others.

00:26:37
Speaker 1: Nice. Yeah.

00:26:39
Speaker 2: Yeah, I think it's something you can do with some exercise in in advance. I think that was Mieke's experience is going to be. Of course, you know, her B&k model . On the one hand, that can help. On the other hand, if it's only dry swimming for students, it doesn't land. So sometimes it also works better to just let them work and do some reflections with it afterwards.

00:27:09
Speaker 1: Indeed. I totally agree with that. So, yeah, with that, I kind of finish my interview, which is already to in the end with 29 mins 30 seconds now. And it's been a very enlightening, yeah, very short interview. I've lost so many questions and thank you so much for politely taking the time and genuinely responding to all the questions. And yeah, it's been very enlightening. Is that any of the comments and questions that you have and tips for my interview that would be highly appreciated.

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00:27:37

Speaker 2: Well, I think you're doing very interesting and very important research, so I'm very glad that it was only in half an hour I could contribute so we can have more talks later. I'm also very interested to From the <mark>Stripes project</mark>, this comenius project that so many so involved in which we are also looking at interdisciplinary project education and how this can be structured. And of course, in that metacognition is one of the topics, but we are also looking more broadly at what kinds of tools are available and how can you can you help make engineering education better in that? So I think you're already talked to minf here already and miles Mcleod you also. Yes.

00:28:36

Speaker 1: Yeah, it is very interesting project, especially the kind of research that I do closely aligns with what the proposal is all about. And yeah, Miles was also been my associate for the qualify it and even the Assessment Committee. And the results was it wasn't my initial recruitment committee and I also spoke with we regularly talked me and zing to exchange ideas and research because we kind of do similar research interdisciplinary from its philosophical point of view. From my educational point of view, we try to complement each other.

00:29:09

Speaker 2: Yeah, yeah. So it's nice and I think that all kinds of complementarity and indeed indeed.

00:29:17

Speaker 1: So, yeah, I do not want to hold you any further. Thank you very much and have a very nice afternoon. And I will try to see you soon in person, hopefully by next month.

00:29:29

Speaker 2: Yeah, it would be nice. And I think for you, it's already evening, isn't it? Or is it?

00:29:33

Speaker 1: Yeah, yeah, it's five. Thirty five, thirty five, thirty six and seven.

00:29:42

Speaker 2: Thank you.

00:29:42

Speaker 1: Thank you. Bye bye.