transcript

00:00:00

Speaker 1: But. So for as a professor or do you how do you what do you mean by higher order thinking s? What is your definition? How do you perceive such? It's.

00:00:15

Speaker 2: I see higher order thinking skills is the ability to master conceptual knowledge and apply it outside the immediate context where it was learned.

00:00:31

Speaker 1: Fantastic. So when you mean conceptual knowledge and able to transfer it outside the classrooms of the educational context, can you break that down into in its box constituent parts?

00:00:47

Speaker 2: I I will try using an example, if that's, you know, an example of conceptual knowledge is the distinction in science between an equilibrium and a steady state. And an equilibrium is a thermodynamic situation where A set of reactions has reached a minimum in Gibbs free energy. And it's something where you can alter the rate at which you get to equilibrium, but you can't change the equilibrium without changing physical contact and things like temperature and pressure a steady state is something where the concentrations of species that you're interested in are not changing because the rate of the Forward reaction and a backwards reaction are equal, but the reactions are chemically distinct. And typically in biology, this is done by X, the continuous expenditure of energy. And when we teach people this conceptually, we use the example of a pump sending water to a bucket that has a hole in it. And if you turn the pump on the level of the water in the bucket with the hole will eventually reach a point where it drips out from the bottom. At the same rate as it's pumped in at the top. But if you turn the pump off, all the water will leave the top bucket. OK, so that's an example of a of a conceptual distinction. It's also an example of how we explain that distinction. And then, for example, asking students to apply it, we would give them. A series of scenarios, and we would give them some. I didn't get that. Could you try again? Sorry, that's just silly. And we would give them a set of scenarios and we'd ask them to tell us which ones of those were equilibrium, which were steady states.

00:03:09

Speaker 1: That's great. That's definitely a lot of information to process. So basically, once you know, at least I've got an understanding of what comes of conceptual distinction that you're trying to explain. How would you observe that in terms of behaviors from students once you've reached that are not?

00:03:30

Speaker 2: Well, so I mean, the example I just gave you is we give them a problem and then we see what they write on the problem in a classroom. I might ask students in the middle of the lecture, is this an equilibrium or a steady state? I can either ask them by. You know, hands up which those of you who think it's an equillibrium, those of you think it's a steady state or I can say, can can someone give me an answer and justify their answer?

00:04:11

Speaker 1: So it is often the kind of conversations, all elaboration that the students can explain what their thinking process is undergoing treatment?

transcript

00:04:21
Speaker 2: Yeah. Well, I'll be very direct. I don't see any. I mean, there's all this sort of you'll have to excuse the word crap about filming the students and looking in their faces to see whether they understand or not. I only believe in one way of figuring out whether students understand which is to to have them give some direct. Expressions in response to a prompt, and you could, you know, in some huge classroom, you could do it with clickers instead of people putting their hands up. But I don't I don't know of any other way of testing people's understanding of things other than to get a direct response.

00:05:09
Speaker 1: Indeed. in your course was in the context of your speech, apart from the content that you test students on the conceptual thinking skills that you mentioned, how do you kind of assess in terms of the greatest example that a student has reached a 70 percent of 80 percent of the time? Do you do that? It is just through your intuition.

00:05:37
Speaker 2: Well, I'm well on things like problems as we grade students and, you know, when we write comments on the problem sets. But I don't think we have a sort of quantitative measure of higher order thinking skills. We have a we have a quantitative measure, obviously, of grades that people get on problem sets and exams. But you know how much of their success is prior knowledge and how much is mastering the concept of in the first place and how much of it is being able to apply the concept outside its original presentation. We don't break things down like that.

00:06:15
Speaker 1: Okay, thank you. Thank you very much. So one final question would be to say what kind of difficulties do you think students experience in acquiring such skills and how can teachers help?

00:06:34
Speaker 2: I guess what I would say is I think there's very wide variations. In a how easily students master these skills, and, you know, we teach an interdisciplinary course and there are some students, I think, who master skills easily when it comes to biological concepts and with more difficulty when it comes to physical ones and there's the exact reverse. I. So I guess I would say the best way to. Roughly speaking, I think there are three ways students master these skills. There are lucky students who have the concepts explained to them, and they sort of, if you like, they master them in real time. I think quite often. And I've certainly had this experience myself. You think you understand the concept in real time. And then you go home when you realize that you didn't. And so now you need help. So the second way that people master things is by practice and trial and error. So that's why we have things like problem sets and stuff like that. And the third way that people master them, especially when they have failed through trial and error and done poorly on problems and things like that. That is that they meet with members of the teaching staff, sometimes the faculty, sometimes the teaching fellows or typically graduate students. In our case, sometimes course assistants who are undergraduates who have previously taken the same course courses the freshman course and then people sit down and and talk it through with students. And quite often using the Socratic questioning to see if you know the penny can be made to drop the school will be like, Oh, now I understand. Yeah, unusual sometimes. Now I

understand really means that some lasting conceptual knowledge has been acquired, and sometimes that means there was a brief flash of understanding. But once they get up and walk away, banish it.

00:09:01
Speaker 1: Indeed, I think I can deliver that experience myself. So if any tools are external things that could help teachers in the process, if anything comes to mind, what could that be?

00:09:14
Speaker 2: I mean, you can, you know, so sometimes we tell our students, you know, some of our students have better math backgrounds and some don't. And we say, you know, you can go on YouTube and on academy and various things like that. Our students regularly ask us for extra problems sets, you know, so that they can practice on on material and. It would I mean, what would be great would be if some academic institution or collaborative of academic institutions decided they wanted to get together and for some particular field of knowledge. You know, assemble a bunch of lectures and exercises in some sort of thought maybe that you could to sort of get people through the hurdle of mastering conceptual knowledge. I think that's a very difficult challenge because, you know, students vary three different ways in my experience their academic preparation. What I'll call their native wit, or you could call general purpose intelligence or whatever you want to know something that I think is actually surprisingly difficult to measure. And then their level of motivation, right and class, I teach at Harvard, so it's quite strongly for a relatively narrow range of all three things. And so I think we have less trouble than big service courses and in those big service courses, the range in all three of those variables is typically large and they're often uncorrelated with each other. So it means roughly speaking, you have a cube whose axes are the three things I just described. And while the students are not uniformly distributed in the cube, they sure are all over it and then figuring out both for the people teach in the class and also in terms of useful external resources, how to find a collection of things that will be useful for students and at all positions in distribution is super challenging

00:11:45
Speaker 1: the indeed challenges I think I've covered most of the things and thank you very much. Do you have any questions and comments and questions? Please do so. And first of all, sorry for my disrespectful behavior. You.

00:11:58
Speaker 2: I was. I mean, staff stuff happens. I had just I mean, what's interesting is I just written an email to you, said, you know, I was on here for 15 minutes. You weren't there and let's cancel is so on your behalf. I'm glad that you showed up. I have been late for many things in my life. Don't fret about it.

00:12:18
Speaker 1: OK, thank you. Thank you. Thank you. Thank you very much for your time and your input has been very valuable. And this year, this is a schedule. I can't thank you enough, so thank you once again. All right.

00:12:28
Speaker 2: Yeah. And if if I have any thoughts about this, I'll let you know. I mean, as I said in

the original email to you, it's it's really hard for me to sort of really rigorously say what a higher order thinking skill is. We just, I mean, I do, and I understand that research is useful, but I think it's a very hard thing to define.

00:12:52

Speaker 1: OK. Yes, thank you. Thank you very much for the final comment. This is why I actually think this issue is trying to figure out a little bit of effectiveness because, yeah, it's great. Thank you very much. I get it. Yeah, yeah. But I.